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INDIAN CENTRAL JUTE COMMITTEE

Annual Report of the Jute Agricultural Research Institute (1955-56)

Calcutta

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ANNUAL REPORT OF THE JUTE AGRICULTURAL RESEARCH INSTITUTE (1955-56)

Introduction

A total area of 55.8 acres was under cultivation of which 45.18 acres were under experiments. During the rabi season 24.5 acres were under different winter crops including potato, pulses, linseed, mustard, etc. the remaining being under seed crop (9.12 acres), Ramie (1.00 acre) and Sisal (0.50 acre). As a result of bulldozing in the previous year the surface soil in some portions of the farm was disturbed heavily thereby bringing about soil heterogeneity in such areas. Due to extreme shortage of land, experiments had to be conducted in these areas also and results of some of the experiments were thus vitiated to some extent.

For want of suitable low and medium lands in the farm double and triple cropping experiments (with jute, paddy and pulses) could not be carried out. These experiments could not also be conducted in the adjacent fields of cultivators as the season was very late. Negotiations are going on with the West Bengal Government for the last 2 years for acquiring an area of 50 acres of low and medium land adjacent to the farm.

The labour situation on the farm showed some improvement ; further improvement can be effected if some arrangements are made to provide a few of them with necessary shelter on the farm area.

As in last year the canal adjacent to our farm was used for retting purposes with the permission obtained through the courtesy of the Executive Engineer, Irrigation Department, West Bengal Government.

The work of the different sections of the Institute suffered much as a number of posts which remained vacant was not filled up.

Season

The season was late and was not very favourable for jute crop under Nilganj conditions. Land preparation could not be done timely and experimental sowings were delayed. Experimental sowings could be taken up only by the first week of June. Though the season was very late, the weather conditions at later stages were favourable for crop growth. During the year under report the total rainfall was 49.30″ and the number of rainy days were 118 of which 12 days had less than 0.04 inch rain. The rainfall and number of rainy days during the year under report are given below:—

Abstract of rainfall for the year 1955-56.

Months.	Total rainfall during the month (inches)	No. of rainy days during the month.	Total rainfall upto the month.
April, 1955	1.61	5	1.61″
May, 1955	1.69	6	3.30″
June, 1955	5.81	17	9.11″
July, 1955	15.03	22	24.14″
August, 1955	6.40	29	30.54″
September, 1955	5.30	16	35.84″
October, 1955	9.60	13	45.44″
November, 1955	1.77	3	47.21″
December, 1955	0.00	0	47.21″
January, 1956	.97	1	48.18″
February, 1956	.84	4	49.02″
March, 1956	.37	2	49.39″
Total :	49.39	118 days	

12 days having below 0.04″ rainfall are also included in the table.

Growth records were kept for plants sown on different dates to assess the influence of weather factors. The data could not be correlated to a high degree of accuracy as all the instru-

ments purchased for the crop weather observatory could not be installed.

Development of the Jute Agricultural Research Institute

The shifting of the remaining sections of the Institute to our permanent building at Nilganj was completed by August, 1955. The work in connection with gas and water supply in the laboratories which was entrusted with the D.G.S. & D. has not been completed. The work of the different sections, particularly of the Chemistry Section is suffering to a great extent for want of running water and gas.

The construction work of the second phase consisting of the 1st floor of the Institute building, 10 units of type III quarters, 14 units type II quarters and 30 units type I quarters are in progress. The construction of 25 units of type II special quarters, rest house, club house and a hospital which are also included in the second phase has not yet been taken up by the C.P.W.D.

The Expert Sub-Committee appointed by the Indian Central Jute Committee recommended the establishment of six Research-cum-Development Sub-stations in the jute growing States in course of three years and fixed the order of priority. The Government of India have provided a sum of Rs. 15.7 lakhs for this purpose. Only the site for Assam could be obtained within the year, but the substation could not be started.

The entire sanctioned amount of Rs. 15.7 lakhs has now lapsed. Land for the substation at Kendrapara has been obtained for the Government of Orissa in April, 1956. Lands in U.P. and Bihar are expected to be obtained very soon. Negotiations are going on with the Government of West Bengal for land in the D.V.C. Commanded area and at Cooch Behar (North Bengal), which have been selected by us for the purpose. Government of India have been approached for the revival of the amount for opening of all the substations.

Nucleus Jute Seed Multiplication Farm.—The land selected for the establishment of this farm near Panagarh was not made available to us this year also. The Ministry of Defence, Government of India have been reminded for the early transfer of the land so that the farm may be started soon.

I. BREEDING AND GENETICS

Short summary of work done last year.

A large number of indigenous and exotic types were collected and prmising ones were carried forward. Eight progeny row trials including *capsularis*, *olitorius* and X-irradiated materials were carried out. Large number of selections were made. Two varietal trials one *capsularis* and one *olitorius* were carried out. Of the *capsularis* varieties, JRC-919 gave 20% higher yield than the control D154, but JRC-212 was at par with D154 although it gave 3 per cent higher yield. JRC-321 maintained a high quality ratio. Of the 5 *olitorius* varieties, JRO-753, JRO-632 and JRO-620, evolved by Jute Agricultural Research Institute, gave 30, 25 and 18 per cent higher respectively than the control C.G.

Results of the varietal trials in the States (11 sown, 5 successful) showed that different varieties gave higher yields in places where optimal conditions peculiar to the variety prevailed. On the whole Jute Agricultural Research Institute strains mostly gave higher yields than the locals.

Eighty-four subvention trials were sown in the five jute growing States of which twenty *capsularis* and nineteen *olitorius* trials were successful. In U.P. JRC-1 and JRC-212 and in Bihar the former proved significantly superior to 'locals' yielding about 30, 25 and 18 per cent higher respectively. In West Bengal the *olitorius* varieties JRO-632, JRO-753 and JRO-620 proved significantly superior to local varieties yielding about 30, 27 and 20 per cent higher respectively.

Selections from polyploid plants evolved by colchicine treatment were carried forward for future studies. Some selections

in X_2 and X_3 generations obtained from X-irradiated materials segregated into normal and aberrant types. Suitable selections were made for further studies.

In order to overcome the cross-incompatibility between *capsularis* and *olitorius* jute, inter-specific grafts were repeated and seeds were collected both from stocks and scions. Crosses between the plants of the 2 species raised from similarly collected seeds of last year, however, did not yield viable seeds.

Several true breeding genetic strains were maintained and some materials were in purification stage. The mode of inheritance of certain leaf types *viz.*, deeply serrated female sterile type, crumpled leaf-types, broad, normal and narrow leaf types were studied. Besides the above similar studies on plant height and earliness were also carried out. Work on these trials were in progress.

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1. Collection of Varieties and Types

129 indigenous samples of jute seeds, 110 *capsularis* and 19 *olitorius,* collected from India and Nepal border, as well as three exotic samples, two *capsularis* and one *olitorius*, obtained from West Africa and Turkey were sown. Composition studies revealed that many of them were heterogenous in respect of pigmentation, maturity and other characters. 200 primary selections, 149 *capsularis* and 51 *olitorius* were made in these type plots, besides 6 *olitorius* primary selections from local cultivators' plots.

2. Breeding

Progeny-row tests.—With a view to test the yield performance of the selections of the previous year, 17 progeny-row trials, 10 *capsularis* and 7 *olitorius* were carried out. The *capsularis* trials included six first year, three second year and one third year trials. The *olitorius* trials included three first year and two each of second year and third year trials. Records of germination, pigmentation, periodical vigour performance, flowering etc., were taken in all these trials. The trials were

harvested culturewise at the small pod stage. A total of 6804 secondary selections, 4580 *capsularis* and 2224 *olitorius* were made. Pigmentation, height, base diameter, date of first flowering etc., were recorded for individual selections.

First year test of selections.—(*i*) *Capsularis*—112 primary selections from the type materials and 26 selections of X-irradiated materials brought forward from the previous year, were tested in six replicated randomized block trials. 2260 secondary selections were made for further studies. On the basis of analysis of the stand and yield data 17 promising cultures were carried forward for further trials.

(*ii*) *Olitorius.*—41 primary selections from type materials and 8 from the X-irradiated materials of the previous year were tested in three replicated randomized block trials. 784 secondary selections were made. On the basis of the analysis of the stand and yield data, six promising cultures were carried forward.

Second year test of selections.—(*i*) *Capsularis*—27 families of five progenies each, brought forward from the first year trials of the previous year were tested in three compact family block trials. On the basis of the analysis of the stand and yield data 11 progenies from eight families which were statistically superior to or as good as the control, D154, were carried forward. 2160 secondary selections were made.

(*ii*) *Olitorius.*—10 families of five progenies each, brought forward from the first year trials of the previous year, were tested in two compact family block trials and 800 secondary selections were made. On the basis of analysis of the stand and yield data, six progenies from the four families which were statistically superior to or as good as the control, C.G. were carried forward.

Third year test of selections.—(*i*) *Capsularis.*—Two families of five progenies each, brought from the successful *capsularis* second year trial of the previous year were tested in a compact family block trial ; 160 secondary selections were made. On

the basis of analysis the stand and yield data four progenies, two from each of the two families, both of which proved statistically as good as the control, D154, were carried forward.

(*ii*) *Olitorius*.—Eight families of five progenies each, brought forward from the second year trials of the previous year, were tested in two compact family block trials. 640 secondary selections were made. On the basis of the analysis of the stand and yield data, six progenies from the families which were statistically superior to or as good as the control, C.G. were carried forward.

Varietal trial.—Two *capsularis* varietal trials were conducted, one with the early and the other with the late varieties.

(*i*) *Capsularis varietal trial No. 1*.—This trial was conducted with six varieties, *viz*., JRC-321, JRC-322, JRC-412, Fanduk (early control), D154 and JRC-212 (late controls). The trial was sown on 3.6.55. Germination ranged from good to fair. The crop suffered from attacks of semilooper and mites at the early stages of growth but it recovered after the pests had been controlled by application of insecticides. The stand and yield data were analysed. The results of analysis of the yield data along with the dates of first flowering, quality ratios and weight C.V.% of the fibre are given below:—

TABLE I.

Capsularis varietal trial No. 1.

Layout—Randomized blocks in six replications.
Gross plot size—27′ × 18′ (1/90 acre approx.).
Effective plot size—25′ × 16′ (1/109 acre approx.).
Date of sowing—3.6.55. Harvested between 1.9.55 and 8.10.55 at small pod stage.

Variety	Yield per acre (Md)	Per cent on control	Date of first flowering	Quality ratio	Weight C. V. %
JRC-212	21.44	187.71	3.9.55	82 ± 1.1	25
D154	16.59	145.26	1.9.55	100 ± 0.4	24
JRC-322	14.97	131.04	14.8.55	110 ± 1.4	24
JRC-321	12.68	111.03	16.8.55	93 ± 0.7	23
JRC-412	11.50	100.67	16.8.55	75 ± 0.8	26
Fanduk	11.42	100.00	13.8.55	103 ± 2.0	27
P	0.01				
C.D.	4.62				
S.E.%	7.93				

From the table above it may be seen that the early varieties JRC-322 and JRC-321 have given about 31 and 11 per cent higher yield than the early control Fanduk though they are statistically in the same group.

(ii) Capsularis varietal trial No. 2.—This trial was conducted with six late varieties *viz.* JRC-212, JRC-918, JRC-919, JRC-5854, JRC-1 and D154 (control). The trial was sown on 3.6.55. The crop affected earlier by attacks of semilooper and mites recovered later. The stand and yield data were analysed. The results of analysis of yield data along with the date of first flowering, quality ratio and weight C.V.% of the fibre are given below:—

TABLE II.

Capsularis varietal trial No. 2

Layout—Randomized blocks in six replications.
Gross plot size—27′ × 18′ (1/90 acre approx.).
Effective plot size.—25′ × 16′ (1/109 acre approx.)
Date of sowing.—3.6.55. Harvested on 8.10.55.

Variety	Yield per acre (Md)	Per cent on control	Date of first flowering	Quality ratio	Weight C.V %
JRC-919	22.12	114.73	5.10.55	91 ± 1.3	21
JRC-212	19.93	103.37	5. 9.55	100 ± 1.3	19
D154	19.28	100.00	3. 9.55	92 ± 1.3	23
JRC-5854	18.63	96.63	6. 9.55	83 ± 1.3	26
JRC-1	17.96	93.15	1. 9.55	89 ± 1.1	21
JRC-918	16.40	85.06	19. 9.55	98 ± 1.3	21
P	0.05				
C.D.	3.41				
S.E.%	6.21				

The treatment variance 2.584 is just less than the 5% value 2.60.

The varieties JRC-919 and JRC-212 have given about 14 and 3 per cent higher yields respectively than the control D154.

(iii) Capsularis Varietal trial in State Farm.—As in the previous year, a trial was conducted under low land conditions

in the Gograghat Farm, U.P. with six varieties viz. JRC-321, JRC-412, JRC-212, Fanduk, D154 and 'local'. The early variety JRC-412 gave the highest yield of 19.8 maunds per acre and was significantly superior to Fanduk and JRC-212. It yielded about 8 per cent and 10 per cent higher than the 'local' (control) and D154 respectively.

Subvention trials in cultivators' plots, 1952-53 to 1954-55. C. capsularis:

Yield data of the successful *capsularis subvention trials* carried out in cultivators' plots during the three years in West-Bengal, Bihar, Assam, and U.P. were analysed and overall performances of the *capsularis* strains were estimated. The results are given below:—

TABLE III.
WEST BENGAL

Variety		Mean yield in Maund.	Per cent on 'Local'.
JRC-13	...	19.10	108.89
D154	...	19.07	108.72
JRC-212	...	18.96	108.10
JRC-1	...	18.61	106.10
Local	...	17.54	100.00

P — Large.

It may be seen from the above that JRC-13, D154 and JRC-212 yielded about 9, 9 and 8 per cent higher respectively than the 'locals' though they were statistically in the same group.

TABLE IV
BIHAR

Variety		Mean yield in Md.	Per cent on local
JRC-1	...	23.20	114.74
JRC-212	...	22.98	113.65
D154	...	22.85	113.01
JRC-13	...	22.17	109.64
Local	...	20.22	100.00
	P	0.01	
	C.D.	2.30	

From the above it may be seen that JRC-1, JRC-212 and D154 proved significantly superior to the 'locals' at 1% level yielding about 15.14 and 13 per cent higher respectively.

TABLE V

ASSAM

Variety		Mean yield in Md.	Per cent on local
JRC-321	...	21.47	117.07
D154	...	20.79	113.36
JRC-1	...	20.54	112.00
JRC-212	...	20.44	111.45
Local	...	18.34	100.00
	P	0.01	
	C. D.	2.12	

It may be seen from above that JRC-321, D154 and JRC-1 proved significantly superior to the 'locals' at 1% level yielding about 17, 13 and 12 per cent higher respectively.

TABLE VI

UTTAR PRADESH

Variety		Mean yield in Md.	Per cent on 'Local'
JRC-212	...	24.57	124.29
JRC-1	...	24.35	123.15
JRC-13	...	22.36	113.09
D154	...	21.95	111.00
Local	...	19.77	100.00
	P	0.01	
	C.D	3.89	

It may be seen from above that JRC-212 and JRC-1 proved significantly superior to the 'locals' at 1% level yielding about 24 and 23 per cent respectively.

Orissa.—Serial analysis of the three years' data is yet to be done. JRC-13 and JRC-212 gave mean yields of 21.3 and 21.1 md. respectively closely followed by D154 yielding 20.9 md. per acre as against 19.2 md. of the 'locals'.

C. olitorius:

West Bengal.—Serial analysis of the three years' yield data is yet to be done. The mean yields per acre of JRO-632, JRO-753 and JRO-620 are 22.24, 21.29 and 20.18 maunds respectively as against 18.5 and 17.7 maunds per acre of C. G. and 'locals'. JRO-632, JRO-753 and JRO-620 thus yielded on an average 25, 20 and 14 per cent higher respectively than the 'locals'. It may be stated here that in individual years, JRO-632 proved significantly superior to both C.G. and 'locals'.

Assam.—Serial analysis of the three years yield data is yet to be done. The performances of the improved strains *viz*., JRO-632, JRO-753 and JRO-620 follow the same trend as in West Bengal.

The results of *olitorius* subvention trials in Bihar, Orissa and U.P. were inconclusive, the data being inadequate for analysis.

Subvention trials in cultivators' plots (1955-56).—102 subvention trials were allotted to the five jute growing states as under : —

State	*Capsularis*	*Olitorius*	*Total*
West Bengal ...	30	—	30
Bihar ...	10	10	20
Assam ...	20	—	20
Orissa ...	10	6	16
U.P. ...	10	6	16
Total : ...	80	22	102

In the *capsularis* trials the following varieties were included —(1) JRC-212, (2) JRC-321, (3) JRC-412, (4) One non-branching strain (JRC-918 or JRC-5854), (5) D154, and (6) Local.

In the *olitorius* trials the following varieties were included —(1) JRO-632, (2) JRO-753, (3) JRO-620, (4) C.G. and (5) Local.

It was decided by the State Directorate of Agriculture, West Bengal that out of the 30 trials allotted to West Bengal only 12

trials would be carried out. Two *capsularis* trials, one each in Bihar and Assam were not sown.

Thus 82 trials in all were conducted in the five jute growing states. Final reports on 8 trials in Bihar are still awaited. Of the remaining 74 trials, 32 trials (26 *capsularis* and 6 *olitorius*) were finally reported to be successful. The remaining 41 trials failed due to various causes such as flood, mistake in sowing, damage by cattle, drought, water-logging in the fields, attack of diseases and pests, etc.

The performances of the varieties in cultivators' plots under different soil and climatic conditions of the jute growing states will be evaluated at the end of three years commencing from the year under report.

Polyploidy—1950 colchicine treated series—(*i*) *C. capsularis* —The two tetraploid lines one full-green and another green-coppery-red were propagated. The materials maintained the distinctive features of polyploids. Selections were made for maintenance ; single pods and bulk seeds were collected from them.

(*ii*) *C. olitorius.*—Seeds of single pods of 12 selections of the four original lines were grown along with the seeds of 4 selections of the narrow-leaf variants. The progenies of narrow-leaf variant segregated into normal and variant. One or two narrow-leaf variants from almost all the selections of the normal tetraploids. A number of normal tetraploids and variants were carried forward.

Studies on the irradiation of jute with X-rays—X_4 generation.—Seeds of 28 *capsularis* selections from normal-looking plants and irregularly serrated wavy-leaf variants, seeds of five pods of a dwarf, stout and late *olitorius* variant with short internodes and two selections of the normal-looking *olitorius* plants of X_3 generation of the previous year were sown. 4 of the *capsularis* selections gave only normal plants ; 13 segregated into plants having irregularly serrated

wavy leaves and normal plants ; 11 segregated into sterile short leaf variants and normal plants. Plants showing wavy-leaf character were still in the process of fixation. Selections were made for further studies. Only one plant was obtained from the seeds of the five *olitorius* pods but it died at the seedling stage. Both the selections of the normal-looking *olitorius* plants segregated into progenies which were dwarf and stout with short internodes but late in maturity and normal-looking plants. Selections were made for further studies.

6 crosses, two between the *capsularis* wavy-leaf variant and the normal and 4 between the *olitorius* variant with short internodes and the normal, were sown, together with their parents. As the parental culture of the *capsularis* wavy-leaf variant segregated into plants having leaves like those of the variant and the normal plants, the F_1 progenies were rejected.

The F_1 progenies of the crosses between the *olitorius* variant with short internodes and the normal were all normal in their appearance. F_1 selection and back crosses were made for further studies.

X_3 generation: *C. capsularis*.—Five normal and branching selections obtained from a family in the X_2 generation of the previous year, which gave branching and non-branching progenies, were sown. Only three non-branching plants were found in one of the cultures and the rest gave normal progenies. Selections were made for further studies. Three *capsularis* selections obtained from the previous year's cultures giving plants with normal and small pods were sown. All of them segregated into plants with normal and small pods. Selections were made for further studies.

C. olitorius.—Two selections obtained from one of the cultures of the X_2 generation of the previous year, which showed segregation in respect of maturity were sown. One of the cultures gave progenies which were late and the other segregated into late and early types. Fresh selections were made for further studies. Variations in respect of leaf and pigmentation

hitherto unobserved were recorded in X_3 and X_4 generation. Selections and crosses were made for further studies.

Vegetative rapprochement as a means of overcoming interspecific cross incompatibility in jute.—Seeds from both stock and scion carried forward from two successful fifth generation grafts of the previous year, were grown. A few sixth generation grafts were made during the year adopting cleft, splice and inarch methods of grafting. All the grafts attempted were successful but they suffered at the late stage due to adverse weather conditions and as a result no seed was obtained from both stock and scion of the grafts.

Genetics of jute

Genetic strains.—102 selections brought forward from the true breeding cultures of the previous year were grown. The germination ranged from good to poor. The progenies of each culture were studied and their respective parental characters, such as, pigmentation pattern, branching habit, leaf shape and size, taste of leaf whether bitter or non-bitter, stipule character, maturity, shape of pod, seed coat colour, etc., were confirmed. 561 selections were made.

70 selections brought forward from the purification series of the previous year were also grown. Eight cultures of the non-branching type, having different pigmentation patterns bred true to their parents. They will be included in the pure series next season. 198 selections having different combination of characters were made for further studies.

Isolation of full-green genotypes.—70 successful test crosses made during the previous year for confirmation of the various full-green genotypes and 27 parents were sown. The progenies of crosses and parents were studied and 13 parents belonging to six full green genotypes were confirmed and selected for inclusion in the genetic strains.

27 fresh crosses were obtained for confirmation of the known genotypes and also for isolation of the remaining genotypes ; the crosses and their parents were carried forward.

Inheritance of character: *Capsularis leaf variant.*—Deeply-serrated, female-sterile type. 25 selections of normal phenotypes from the segregating families of the previous year were grown. The number of families segregating and the normal and variant segregates in them were recorded. Field studies have been completed and the data are being studied. The variant will be maintained in our stock of genetic strains.

Crumpled-leaf mutant:—(*i*) *Capsularis*—18 back crosses to the recessive crumpled-leaf type, six selection of F_1 progenies and four parents were grown. The F_2 and the back-cross families segregated into 3 normal : 1 crumpled and 1 normal : 1 crumpled ratios respectively showing that the inheritance of the crumpled-leaf character is monogenic, the normal leaf being dominant over the crumpled-leaf.

(*ii*) *Olitorius*.—Three crosses of the crumpled-leaf mutant made during the previous year, two with dark-red normal and one with green *olitorius* normal were sown. The F_1 progenies were all normal. 16 back-crosses covering all the combinations were obtained. 7 selections of the F_1 progenies, 3 of the parents and the back-crosses were carried forward.

Inheritance of plant height.—Seven F_1 six F_2 and 23 back-cross families along with eight selections of parents were grown. Germination was very poor and all the materials had to be rejected.

Inheritance of earliness in C. capsularis.—31 back- crosses and 42 F_1 selections of the inter-varietal crosses covering various combinations of early, medium and late types brought forward from the previous year, were grown along with 39 selections of parents. Besides, four fresh crosses, repeated last year, were also sown. The variations in respect of maturity among the progenies of the back-crosses and the F_2 families were noted and bulk seeds as also seeds of selections from promising families were collected for further studies.

Fresh crosses, back-crosses, F_1 and F_2 selections of crosses between the late parent, D154 and Maniksari, the early parent

were also sown along with their parents during the year. Flowering date, pigmentation, plant height and base diameter of the crosses, parents, F_1 and F_2 families were recorded. Fresh crosses were made and the promising progenies of the back-crosses families were further back-crossed with the recurrent parent D154. Crosses F_1, F_2 and F_3 selections were carried forward for further studies in their next generation.

Inheritance of blotched leaf character in C. olitorius.— To study the mode of inheritance of this character, a deep red *olitorius* type with blotched leaf was crossed to JRO-753, a green type with non-blotched leaf during the previous year. The leaves of the F_1 progenies were all blotched. Back-crosses, F_1 selections and parents were carried forward for further studies.

Chlorosis

Six true breeding chlorotic cultures, four *capsularis* and two *olitorius,* along with seven chlorotic and non-chlorotic selections from the segregating plots of both the species brought forward from the previous year, were grown. The performances of the progenies of these cultures were studied. All the pure cultures were found to breed true to their parents. Among the segregating cultures, only one *olitorius* selection was found to be breeding true for the non-chlorotic character for which it was selected and the rest segregated into chlorotic and non-chlorotic progenies. In all, 31 selections were made from both pure and segregating families of *capsularis* and *olitorius* for further studies.

Nine back-crosses with both chlorotic and non-chlorotic parents, six F_1 and four F_2 families carried forward from the previous year were also grown. As already reported, the back-crosses with the non-chlorotic parent and the F_2 families segregated into chlorotic and non-chlorotic progenies during the early stages but with the onset of reproductive phase, almost all the progenies became chlorotic. The back-crosses with the chlorotic parent were, however, all chlorotic.

Among the F_3 families, the progenies of one of the chlorotic selections were all chlorotic and those of the rest behaved like F_2 families.

II. CYTOGENETICS

Short summary of the work done last year.

Work on interspecific hybridization was carried out using diploids and autotetraploids of different varieties as well as wild types. In this connection detailed study of the pollen grains were carried out. Cytological investigations were conducted on different aspects in order to find out and overcome the cross-incompatibility in the two species and for exploring possibilities of breeding new types.

Interspecific hybridization

The few full seeds that were obtained last year in certain crosses failed to germinate. Further interspecific crosses between the cultivated as well as between the wild types of *olitorius* and *capsularis* were made at their diploid and tetraploid level. The setting of pods was observed in practically all the crosses. Most of these set pods fell down during their growth. The pods ultimately harvested ranged from well developed matured pods to slightly developed ones ; the size of the biggest matured pod never equalled the size of the normal pod of the parents. The quantity and quality of seeds produced varied a great deal in different crosses including their reciprocal ones.

The cause of failure of the partially full and full seeds to germinate may lie in the improper development of embryo, or antagonism between embryo and endorsperm during growth or germination or some sort of irregular post-fertilisation development connected with these tissues.

Incompatibility studies.—Sections of some pistils of C.G. collected after pollination with D154 at different intervals were cut to the thickness of 10 μ . The sections were stained in

0.125% resorcin blue for 30 minutes. Further work is in progress.

Cytological investigations of autotetraploid of C. olitorius (C.G.)

A great variation in chromosome pairing is recorded. Hexavalents, pentavalents and trivalents were occasionally found besides the commonly occurring quadrivalents, bivalents and univalents. In few p.m.c's perfectly normal (14II) pairing was seen. Maximum number of quadrivalents noticed were four. The various configuration of quadrivalents observed are arranged in the order of occurrence, most common being the ring and chain shaped ones. This wide variation in the shape of quadrivalent formation indicates that these are fundamental differences in the groups of chromosomes ; this further suggests that the original diploids from which these autotetraploids have arisen, are themselves secondary polyploids. In few p.m.c.'s interlocked bivalents were also found.

Out of 581 p.m.c.'s analysed at metaphase I, 67.1% of them had univalents. Maximum number of univalents noticed was six. Presence of two univalents in a p.m.c. was very common. Lagging chromosomes are frequently seen (in 55% of the p.m.c's) at anaphase and telophase I. The number of laggards varied from 1 to 6 in them. Chromosome elimination was noticed at telephose I. At metaphase II, the number of p.m.c.'s with univalents accompanying with or without chromosome bodies eliminated were relatively less than the ones during metaphase I. Lagging chromosomes, multispindles instead of normal two, and the chromosomal bodies lying out in cytoplasm were seen at anaphase II. The distribution of the chromosomes in both the divisions is highly irregular.

Large number of sporades were analysed for the number of microspores and micronuclei in them. Monads to octads with or without micronuclei have been recorded. Pollen grains were stained in aceto-carmine. Their analysis showed that the percentage of stained grains and their size varied much

in different plants. Pollen germination (in 15% sucrose solution by hanging drop method) has been studied in autotetraploid vs. diploid.

Studies on the genesis of sperms in the pollen tubes of two cultivated jute species

The tube nucleus usually precedes the generative cell; rarely the generative cell migrates ahead of it in the pollen tube. In the pollen tube, the chromatin matters of different size and shape are noticed. The long threads which are commonly seen in the tube either have a split at one or both ends or/and have prominent chromatin lumps or small globules here and there along their lengths; sometimes the threads are found lying side by side suggesting that they are in a prophasic stage of development. The prominent Feulgen-positive chromatic lumps seen here and there on the thread seem to be excess amount of hetero-chromatin. The thread or threads are also been encircling the nucleolus of the generative cell partially or entirely.

At prometaphase stage short chromatin bits with longitudinal splits are noticed. They are of varying lengths and separate irregularly before they arrange themselves on the equatorial plate as chromosomes. Nucleolus disappears earlier. The chromosomes divide equationally. Neither a cell plate nor any film of dark staining material across the spindle at the equator is noticed.

During metaphase and anaphase the chromatin matters of varying size and shape are observed lying in the generative cytoplasm and away from the plate. The chromatin matters particularly the larger ones are more likely the eliminated chromosomes or excess quantity of heterochromatin which are being thrown out during disjunction. The chromosomes separate and arrive at two opposite poles; at first they are clumped together. Subsequently chromatin network appears with nuclear membrane around them. Chromatin threads gradually get thickened and a small nucleolus appears, just about the time when cytokinesis is to take place. Constriction furrows

appear at nearly the middle region of the cell cutting the cell into two halves, each one on maturity becoming a sperm. Each sperm nucleus is surrounded by its own cytoplasm.

III ANATOMY

Short summary of the work done last year

In the study on the relationship between the dimensions of ultimate fibres and the quality of jute, it was found that in better quality yarns ultimate fibres tended to be long and slender and that the length breadth radius was comparatively higher. It was shown that phosphorus increased the density in the fibre wedge by increasing the number of layers, while nitrogen increased the total number of fibre wedges. Fibre samples received from various places were examined and required technical informations were furnished.

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1. Structure and quality of fibre

From a study of the relationship of ultimate fibres and quality of jute it has previously been observed that long and slender ultimate fibres are associated with good quality. To find out the varietal difference with regard to these characters, the length, breadth and lumen size of the ultimate fibres were measured in the *capsularis* varieties, JRC-212, Fanduk, JRC-1, D154 and JRC-919. The data are yet to be analysed.

2. The effect of fertilisers on the formation and structure of fibres

The results of this study were reported in part last year. The work was continued and the following aspects were studied this year. The data were statistically analysed and the conclusions may be summarised as follows :

(*a*) *Number of ultimate fibres in a cross-section of a fibre strand.*—With the application of ammonium sulphate, the number of ultimate fibres increases significantly. The increase in number, with the application of compost, is not significant. There is no difference with superphosphate.

(*b*) *Breadth of the ultimate fibres.*—With the application of compost and ammonium sulphate, the breadth of the ultimate fibres increases significantly. Though statistically insignificant, there is a tendency of decrease in breadth with the application of superphosphate.

(*c*) *Thickness of the wall.*—There is no difference with any treatment.

(*d*) *Length of the ultimate fibres.*—There is no difference with any treatment.

(*e*) *Wood-bast ratio.*—The proportion of wood in relation to the bast region increases with the application of compost and ammonium sulphate. With superphosphate, there is no difference.

Work on all aspects will be repeated next year for confirmation of the results obtained.

3. Routine identification of fibre samples

Fibre samples received from various sources were examined microscopically and necessary informations were supplied.

IV PHYSIOLOGICAL INVESTIGATIONS

Short summary of the work done last year

Studies on the physiology of jute seeds gave certain important results showing that good quality of seeds as well as fibre might be obtained from the same plant by judicious selection of the harvesting time. Good viable seeds can be obtained by collecting the half-mature capsules and by allowing them to ripen and dry under laboratory conditions, while plants can be harvested for the fibre. Detailed results were obtained on the nature and range of flowering phase in the life-cycle of almost all the economic varieties, which have been correlated with the variations in different growth components responsible for the yield of fibre. The growth data gave further insight into the performances of the different varieties. A new method of estimating fibre-content by stripped bark method has been evolved whereby an estimate of fibre content of individual plants

in the field can be made without resorting to long drawn process of retting after harvesting the plant. Salt and drought resistance of cultivated as well as wild varieties were studied but field experiments could not be conducted due to lack of irrigation facilities in Kakdwip area, where such experiments were scheduled for conduction. The nutritional requirements of jute plant was investigated under cultural conditions. Experiments were undertaken to study the quality of fibre in relation to growth and maturity.

Investigations on the physiology of the jute seeds

(*i*) *Viability efficiency of seeds collected at different stages of maturity.*—The work was continued with D154, Fanduk and JRC-212 (*capsularis*) and C.G., JRO-632 and JRO-753 (*olitorius*). The production of seeds varied according to the nature of the growth of the varieties. It was found that seeds from the *capsularis* varieties, collected at half matured capsule stage showed higher percentage of germination than seeds from *olitorius* varieties of the same stage. The above results were correlated with different stages of harvest for dual purpose of growing jute.

(*ii*) *Investigations on the dual purpose of harvesting.*—The experiment was continued this year with D154, Fanduk, JRC-212 (*capsularis*) and C.G., JRO-632 and JRO-753 (*olitorius*). Further details were obtained on the time of harvest in these varieties when they can be grown profitably for fibre as well as seed. As noted before, fibre and seed could be obtained from the same crop but at the cost of a little loss of fibre yield about 6 to 10 per cent in *capsularis* varieties and 4 to 6 per cent in *olitorius* varieties.

Nature and range of flowering and seed formation in different varieties of jute

The study was continued for the fifth year during this season. The seeds collected from the different points of flowering range in the varieties—D154, Fanduk, Japred

JRC-212, J RC-13, JRC-321 (*capsularis*) and C.G., R-26, JRO-620, JRO-632 and JRO-753 (*olitorius*) were studied for (1) flowering (earliness or lateness), (2) nature of flowering range, (3) vegetative growth or performance.

In course of the study some interesting results were obtained which throw light on the (1) correlation of vegetative and reproductive phase in different varieties, (2) variations in the rate of fibre production in relation to other growth components during the two phases, (3) inheritance of flowering with reference to lateness or earliness, (4) performance of seeds formed at different points of weeks of flowering range with reference to the frequency distribution of height attained.

Further comprehensive data on the above aspects would be followed up in 1956-57. Detailed analysis of the results are in progress and some tentative conclusions arrived at, are as follows:—

(*a*) Nature of flowering period in the two species of *capsularis* and *olitorius* is different, as already reported. Within the species, the different varieties show the same nature of the flowering curve, but individual varieties show differences as to the range and optimum values of the curve.

(*b*) The transition of vegetative phase into reproductive phase and the period of correlated activity of both the phases was more restricted in *capsularis* varieties than in *olitorius* varieties where the correlated activity of both the phases was stretched over a longer period in the life cycle of the plant.

(*c*) The nature and rate of fibre formation was also correlated with the nature of flowering curve.

(*d*) The distribution of fibre percentage along the growth of the stem as well as in different phases of growth varied in different varieties according to the nature of transition period from vegetative to the reproductive stage.

(*e*) The detailed study of the progeny raised from seeds collected at progressive weeks of flowering showed differences in the frequency of vegetative growth performance. The results indicated a better performance in heights attained in seeds collected at later periods of flowering curve.

Effect of vernalization and photoperiods on the phasic development of jute plants

The study of the effect of temperature and different photoperiods was continued in the varieties—D154, Fanduk and JRC-212 (*capsularis*) and C.G., JRO-632 and JRO-753 (*olitorius*). Under normal conditions the above varieties show different dates of flowering and the response to short days and long days was also found to be different in different varieties. In order to find out the nature of photoperiodic reaction, the following experiments were continued—

(*a*) Curtailing light period to short days (8 hours and 10 hours) light period in the morning.

(*b*) Curtailing light period to short days in the evening.

(*c*) The above treatments were given in the plants of 15 days' growth, 30 days' growth and 45 days' growth, for a period of 21 days and then allowed to grow under normal conditions of day and night.

All the experiments were carried under field conditions and the light was curtailed by covering with specially designed well-ventilated wooden boxes. The results indicated the following tentative conclusions:—

(1) All the varieties responded to short day lengths, showing earliness in flowering than the controls.

(2) Individual varieties showed different degrees of earliness which depended also on the stages of the plants when the different photoperiods were given.

(3) The varieties JRC-212 (*capsularis*) and JRO-632 and JRO-753 (*olitorius*) showed greater earliness than the other varieties.

(4) It was found that curtailing the light period in the evening when plants get a dark period of 14 hours or 16 hours in continuity with night following was more effective than shortening the light period with the sunrise in the morning and giving light period later in the day.

Further work on the above aspects will be taken up next year.

Experiment on salt tolerance in jute

Field experiments could not be conducted properly due to the difficulties in getting land in the saline area and of working conditions by way of uncertainty of drought and later heavy rains in the saline tracts of Kakdwip area where field trials had been attempted for the last three years.

(*i*) *Field experiments in the saline area of Kakdwip in Sundarbans area.*—5 *Capsularis* varieties—D154, Fanduk, JRC-212, JRC-321, JRC-13 and 5 *olitorius* varieties—C.G., R-26, JRO-620, JRO-632 and JRO-753 were sown in replicated plots. The salt concentration of the soil at the time of sowing varied from 1.0 per cent to 2.0 per cent of Nacl. About 50 per cent of the seeds of *olitorius* varieties failed to germinate but seeds of *capsularis* varieties showed 80 per cent germination. The growth of *olitorius* varieties was very poor and ultimately the few plants that survived showed very stunted growth. Seeds were collected and tested for germination showing viability, 68 per cent in C.G. and 60 per cent in JRO-632 on average.

The *capsularis* varieties showed better growth with higher percentage of survival reaching an average height of 3 feet in D154 and 3′-6″ in JRC-212. The plants were retted in the available canal water and retted fibre showed good quality. The seeds collected had germination of 80 and 91 per cent res-

pectively. The results indicated a better tolerance in *capsularis* varieties and JRC-212 showed the best performance under the above field conditions.

(*ii*) *Experiments with wild seeds.*—The wild species, *C. siliquosus*, *C. tridens* and *C. trilocularis* were tested for salt tolerance. They tolerated a higher concentration of 2.0% NaCl but the germination was very slow and delayed as usual in the case of wild species.

(*iii*) *Inducing tolerance by pre-sowing treatment with different salt concentrations.*—Attempt was made to induce tolerance by pre-sowing seed treatment with different concentrations of NaCl and raising seedlings for further investigations. Indications were obtained for a slight increase in the salt tolerance. Further work is in progress.

Investigations on the variations of growth components during the life cycle of the plant

Some of the important results obtained have already been described in the previous reports. The above aspect of work has given an insight into the nature of the fibre growth in relation to other important factors like rate of vegetative growth, transition of reproduction stage, distribution of growth components along the stem as well as during the various growth phases of the plant, and relation of the formation of other growth components. From the above findings the fibre percentage and the fibre content of a plant can well be studied on a comparative basis in individual varieties during their life cycle. The fibre percentage is an important criterion, to assess the performance of a variety in addition to the factors like basal diameter and height.

Based on findings already obtained the new method evolved for estimating fibre content by stripped bark weight (described in the previous annual report) was given a wide field trial. The four important varieties—D154, JRC-212 (*capsularis*), C.G. and JRO-632 (*olitorius*) were worked upon and their stripped bark weight, corresponding height, basal diameter and total bark

weight of the stem at two stages—(bud and early capsule) have been estimated. Their co-efficient of correlation from various aspects are being worked out, in order to find out the possibility of utilizing such results as an additional criterion for selection of plants. The fibre percentage of different varieties have been worked out in relation to green weight, dry weight, bark weight and wood weights. The results have indicated specific as well as varietal differences. Preliminary results have shown that fibre percentage is an important factor to judge the fibre-producing potentiality of a variety and this character is to be studied in all details for use in a programme of plant selection.

Further studies are being made to estimate fibre percentage with the help of the stripped bark method under field conditions.

Growth sequence in relation to stalk and foliage

The experiment was continued in the N, P, K trial conducted in pots under cultural conditions with D154 (*capsularis*) and JRO-632 (*olitorius*). The previous results were obtained from N, P, K trial conducted under field conditions by the Agronomy Section. In the cultural experiments the proportions of N, P, K was maintained as in previous years, but three concentrations were used—0.125%, 0.25% and 0.375% in respect of the soil. The height, basal diameter and leaf output were recorded at fortnightly interval for the different treatments.

Preliminary results showed that the higher concentrations of 0.375% of all the nutrients were detrimental to plant growth and a definite set back in the growth was obtained. The rate of growth in nitrogen series in presence of phosphorus was more marked than in absence of phosphorus. The proportion of stalk growth and foliage growth in terms of green weight also showed proportional increase in nitrogen series. But in presence of potassium more foliage was produced. The different concentrations of nitrogen showed different effects in D154 and

JRO-632. This aspect has been studied under nutritional experiment.

Experiments with different nutritional levels

(*i*) *Effect of different manures and their combinations on the growth of jute under field conditions.*—For this study, the materials (D154 and JRO-632) were taken from the manurial trial conducted in the Agronomy Section where different doses of nitrogen, phosphorus and potassium and their different combinations were used. The treatment consisted of 3 levels of nitrogen (0 lb., 20 lb. and 40 lb N per acre); 2 levels of phosphates (0 lb. and 40 lb. P_2O_5 per acre) ; 2 levels of potash (0 lb. and 25 lb. K_2O per acre). The growth of main stem in terms of fresh green weight and the weight of foliage produced at each period of 3 weeks interval was estimated.

The results indicated that nitrogen, phosphorus and potassium influenced the growth as compared to no-manures. The influence of nitrogen as N_1 and N_2 alone was the most prominent than either phosphorus or potassium. Performance of nitrogen was more influenced in combination with phosphorus, than with potassium. In general, the same influence was noticed in both D154 and JRO-632, but D154 recorded more increased growth in nitrogen levels than in JRO-632.

(*ii*) *Cultural experiments in pots with N,P,K*—The field trials were repeated under controlled pot culture experiments, but in different concentrations of N, P, K in terms of the dry soil contained in each pot. Three different concentrations 0.125%, 0.250% and 0.375% of N, P, K were used in various combinations as before. In higher concentration of 0.375% of all the nutrients the plants received a set back in growth. Nitrogen in combination with phosphrous gave better growth than nitrogen alone. The role of potassium was not clearly seen. The experiment would be continued next year.

(*iii*) *Sand culture experiments in presence or absence of trace elements as Mn, Zn and Bo*—Experiments were conducted with sterilized sands in glazed earthenware pots which were

covered with water tight wooden covers having two holes for carrying two plants in each pot. Hoagland nutrient solution was used and frequently changed with fresh solution. The results showed that in absence of Zn and Mn the plants were deficient in chlorophyll and general growth was affected. Boron deficient cultures were of stunted growth and tips were affected.

V. JUTE AGRONOMY

Short summary of work done last year

In experiments with variety-cum-spacing-cum-manures with both *capsularis* and *olitorius* jute the combined treatment effect was statistically significant, which showed that the late varieties D154 and JRO-632 were superior to early varieties. Manurial responses were found to be more marked with early varieties than with the late varieties.

In the study of nitrogen, phosphorus and potassium as manures significant results were obtained in various manurial treatments in *capsularis* only. Application of nitrogen in combination with potash increased the yield by 29% to 53% over the control plots. But with *olitorius* jute, these responses were not so very prominent. Effect on the proportion of organic and inorganic nitrogen showed no significant differences with regard to yield in *olitorius jute*. *The capsularis* trial was abandoned due to poor stand. In jute split application of ammonium sulphate did not show any advantage over single application. In experiments to ascertain the comparative merits of various nitrogenous fertilizers applied at 30 lb. N per acre on both *capsularis* and *olitorius* jute, the effect due to fertilizers were significant. Ammonium sulphate gave significantly higher yields than Chilean nitrate, urea, ammonium sulphate nitrate. The varietal effect and the effects due to interaction (fertilizers and variety) were not significant.

In an experiment to study the comparative merits of organic manures against ammonium sulphate applied at 5 levels (0 lb., 20 lb., 40 lb., 60 lb. and 80 lb. N per acre) the results

showed that the higher doses (60 lb. and 80 lb. N) of mustard cake, compost and ammonium sulphate gave significantly higher yields than F.Y.M. and sludge in *capsularis*. The treatment differences were not so marked in *olitorius* trials.

Simple manurial trials were conducted in non-acid zones in Assam, Bihar, Uttar Pradesh and Orissa. Trials in acid zones were confined to Bihar only. No trial was conducted in West Bengal. In general, higher dose of nitrogen in combination with potash or together with phosphorus gave higher yields in trials conducted in Assam and Bihar, while in Orissa the lower dose of nitrogen was found almost equally good. In Uttar Pradesh the lower dose of nitrogen was equally effective as the higher dose either alone or in combination with potash or phosphorus or both.

In experiments to study the effects of different dates of sowing in yield and quality of fibre and also to study the behaviour of different varieties sown on different dates, the result showed that the April sowing gave significantly higher yield of fibre than other sowings. Late varieties of both *capsularis* and *olitorius* proved significantly superior to early varieties.

Last winter the entire layout of the farm was remodelled after levelling the land with the help of a bulldozer. The surface soil as such was greatly disturbed. A number of small irregularly shaped plots which could not be utilized for experimental purpose were brought in compact plots of convenient sizes. All these resulted in a marked heterogeneity in most of the blocks. For extreme scarcity of land some of the trials had to be conducted in those affected plots after application of a general basal dressing of town compost. These trials were greatly affected and the result showed somewhat irregular responses.

Variety-cum-manurial trial

(*i*) To study the responses of different varieties of jute at various levels of fertilizer (ammonium sulphate) two trials

one with *capsularis* and another with *olitorius* were laid out. Four varieties of each of *capsularis*, viz., JRC-212, JRC-321, D154 and local and of *olitorius*, viz., JRO-632, JRO-620, C.G. and local were included in the trials. The manurial levels were 0 lb. N, 20 lb. N, 40 lb. N and 60 lb. N per acre from ammonium sulphate in both *capsularis* and *olitorius*. Fertilizer was applied at the time of sowing. The crops were sown in lines by a seed-drill. Germination in the case of *capsularis* was gappy. A long drought followed shortly after sowing affected the crop adversely in the very early stage, but made up considerably later on. The analysis of data of the *olitorius* trial revealed that the effects due to different levels of fertilizer and varieties were both significant at 1 p.c. level but that due to interaction (different levels of fertilizer and varieties) was insignificant. It was found that the application of fertilizer increased the yield significantly, 20 lb. N giving 3.8 md. extra fibre per acre over the control (0 lb. N); but there was no significant difference among the treatments with 3 different levels of fertilizer (*i.e.* 20 lb. N, 40 lb. N and 60 lb. N). The varieties JRO-632 and local proved significantly superior to C.G. giving an extra yield of 3.5 maunds per acre. From the general characteristics the local appears to be an improved type of the Jute Agricultural Research Institute.

TABLE VII

Mean yields (in md./acre) of varieties, manures and their combinations.

Treatment	JRO-632	JRO-620	C.G.	Local	Mean yield at each manurial level
0 lb. N/acre	18.90	15.24	13.94	17.92	16.50
20 lb. N/acre	22.01	19.04	18.52	21.59	20.29
40 lb. N/acre	20.83	19.36	17.47	21.50	19.79
60 lb. N/acre	20.09	19.88	17.53	19.05	19.14
Mean yield per variety	20.45	18.38	16.87	20.01	

In *capsularis* the responses due to different levels of fertilizer, varieties and interaction (fertilizer and variety) were all found to be insignificant. Though the yield of fibre increased with the increase of doses up to 40 lb. N per acre, there was no significant difference among the treatments with varying doses of N. This is, however, contrary to our previous findings. Among the varieties, JRC-212 gave higher yield of fibre than the remaining 3 varieties but this difference also proved to be insignificant. Soil heterogeneity was perhaps responsible for such peculiar results as was evident from the high F value of the block variance.

(*ii*) It was proposed to conduct five variety-cum-manurial trials one in each of the five jute growing States, under varying soil and climatic conditions in the following manner :

1. One trial (*olitorius*) at State Agri. Farm Berhampore, W. B.
2. „ „ (*capsularis*) „ „ „ Gograghat, U.P.
3. „ „ „ „ „ „ Balia, Orissa.
4. „ „ „ „ „ „ Purnea, Bihar.
5. „ „ „ „ „ „ Karimganj, Assam.

Only 4 trials one each at Gograghat (U.P.), Balia (Orissa), Purnea (Bihar) and Berhampur (West Bengal) were conducted during the year under report. In Assam no trial could be taken up for various reasons. The trials at Balia and at Purnea were greatly affected by continuous drought which followed shortly after sowing. Due to poor crop growth and their stand the two trials had to be abandoned.

From the results in the trials in West Bengal the manurial responses were found to be rather erratic and no difinite conclusion could be drawn. Among the varieties JRO-632 gave highest yield of fibre. In the U.P. trial also the result was somewhat inconclusive. Among the manurial levels 20 lb. N gave the highest yield in JRC-212, JRC-321 and local whereas D154 yielded best with application of 40 lb. N. Among the varieties tested JRC-212 proved best so far as yield of fibre was concerned

Effect of nitrogen, phosphorus and potash

To study the effect of different doses of nitrogen phosphorus and potash and their various combinations on the yield and quality of fibre, two trials, one with *capsularis* and another with *olitorius* were repeated for the third consecutive year. The treatments in either trial included 3 levels of nitrogen (0 lb. and 20 lb. and 40 lb. N per acre), 2 levels of phosphorus (0 lb. and 40 lb. P_5O_2 per acre), 2 levels of potash (0. lb. and 25 lb. K_2O per acre) and the combinations thereof. The fertilizers applied were ammonium sulphate, superphosphate (single) and muriate of potash. The varieties used were D154 and JRO-632 for *capsularis* and *olitorius* respectively.

In both the trials the crops suffered greatly from the attack of semilooper and hairy caterpillar. They, however, recovered considerably when proper and timely remedial measures were adopted. In the *capsularis* trial the effect due to application of nitrogen was significant at 1 p.c. level. It was found that the application of higher doses of N in combination with P and K singly or together tended to increase the yield. The responses due to application of P or K or PK were found to be insignificant. The treatment 40 lb. N alone gave the highest yield of fibre of 24.8 md. per acre as against 17.8 md. from the control. The serial analysis of the data for the last 3 years is yet to be done.

In *olitorius* the data of 3 successive years (1953-54, 1954-55 and 1955-56) were analysed and it was noted that the sources of variations due to (*a*) year, (*b*) nitrogen alone, (*c*) interaction—year and nitrogen, (*d*) block and (*e*) interaction between block and year were significant at 1 p.c. level. The yield responses to N_1 and N_2 and their combinations with either P or K or both were found superior to the control at 1 p.c. level of significance. The effects of P or K or PK did not prove to be superior to that of control. The highest yield of 27.03 md. per acre was obtained from $N_2P_1K_1$ as against 21.22 md. of the control. The application of fertilizers increased the yield of fibre from 10 to 27 per cent over control (no manure).

Comparative merits of various nitrogenous fertilizers on capsularis and olitorius jute

To study the comparative merits of various nitrogenous fertilizers on the yield and quality of fibre a trial was laid out in split plot design with both *capsularis* and *olitorius*. The fertilizers tried were ammonium sulphate, sodium nitrate, potassium nitrate, urea, ammonium sulphate nitrate, chilean nitrate, 'Paul's mixture' and 'Talukdar's mixture'. Fertilizers were applied on the basis of 30 lb. nitrogen per acre. The varieties used were JRC-212 for *capsularis* and JRO-632 for *olitorius*.

The behaviour of JRC-212 and JRO-632 to different nitrogenous fertilizers is shown in the table below: With *capsularis* (JRC-212) the highest yield recorded was 22.21 md. from the application of Sodium nitrate closely followed by Ammonium sulphate (22.09 md.) and Potassium nitrate (22.02 md.) as against 19.07 md. of the control. In case of *olitorius* jute Paul's mixture (21.80 md.), Potassium nitrate (21.47 md.), Ammonium sulphate nitrate (21.19 md.) and Ammonium sulphate (21.16 md.) gave almost the same response giving an extra yield of 11 to 15 per cent.

TABLE VIII

Treatment	*Mean yield of fibre in md. per acre*	
	C. capsularis (JRC-212)	*C. olitorius* (JRO-632)
1. Sodium nitrate	22.21	20.26
2. Ammonium sulphate	22.09	21.16
3. Pot. nitrate	22.02	21.47
4. Talukdar's mixture	21.04	19.86
5. Chilean nitrate	21.72	20.38
6. Ammn. sulphate nitrate	21.44	21.19
7. Urea	20.66	19.83
8. Paul's mixture	19.25	21.80
9. Control (no manure)	19.07	19.02

Olitorius crop had a serious attack of white ants in the later stages when the crop was greatly damaged and as such high variation of stand between the varieties was recorded at the

time of harvest. The analysis of data on fibre yield and stand are in progress.

Comparative merits of organic manures against ammonium sulphate on jute

With a view to study the effect of various sources of organic manures as against ammonium sulphate on the yield and quality of fibre two trials, one with *capsularis* and the other with *olitorius* were conducted. The manures applied were compost, sludge, F.Y.M., mustard cake and ammonium sulphate at various levels of N *viz.*, 0 lb., 20 lb., 40 lb., 60 lb. and 80 lb. per acre. The varieties used were JRC-212 for *capsularis* and JRO-632 for *olitorius*. Organic bulky manures were applied at 50 per cent N availability basis at the time of sowing. Application of ammonium sulphate was done in two equal instalments, half quantity at the time of sowing and the remaining half as top dressing in 35 days old crop. Germination was found to be very good. The *olitorius* suffered greatly due to a serious wide-spread attack of white ants in the trial, the trial had, therefore, to be rejected. From the analysis of data of the *capsularis* trial it was found that although organic manures yielded more fibre than ammonium sulphate, the differences were not significant. There was also an increase of fibre yield with an application of higher doses of manures. The percentage increase in yield varied from 5 to 22 over 0 lb. N (control). This insignificant treatment differences were probably due to the soil heterogeneity.

Manurial trials in States

To determine the manurial behaviour on jute under different soil and climatic conditions and also to demonstrate their effects to the cultivators, simple modified trials under cultivators field conditions were conducted for the second year in the various jute growing States of West Bengal, Bihar, Assam, Orissa and U.P. The trials were carried out in both acid and non-acid zones. The treatments of each were as follows:—

A. *For non-acid zone*
   1. No manure (control).
   2. 20 lb. N per acre.

3. 30 lb. N per acre.
4. 30 lb. N plus 40 lb. K_2O per acre.
5. 30 lb. N plus 30 lb. P_2O_5 ,, ,,
6. 30 lb. N plus 40 lb. K_2O plus 30 lb. P_2O_5 per acre.

B. *For acid zone*

1. No manure (control).
2. 20 lb. N per acre.
3. 3 mds. lime alone per acre.
4. 6 mds. lime ,, ,, ,,
5. 3 mds. lime plus 20 lb. N per acre.
6. 6 mds. lime plus 20 lb. N ,, ,,

(The fertilizers used in the trials were ammonium sulphate for nitrogen, muriate of potash for K_2O and single superphosphate for P_2O_5).

The table below gives the list of trials conducted during the year under report.

TABLE IX

	Trials scheduled			Trials successful			Total number of trials failed or rejected or not conducted.
	Acid zone	Non-acid zone	Total	Acid zone	Non-acid zone	Total	
1. Bihar ...	1	50	63	13	32	45	23
2. West Bengal		30	30		19	19	11
3. Assam ...		30	30		14	14	16
4. Orissa ...		25	25		16	16	9
5. U. P. ...		25	25		9	9	16
Total ...	18	160	178	13	90	103	75

Bihar.—Out of 68 trials originally scheduled, 18 for acid zone and 50 for non-acid zone only 13 trials were successful in acid zone and 32 in non-acid zone. In non-acid zone, on an average, 30 lb. N together with 30 lb. P_2O_5 and 40 lb. K_2O per acre gave the highest yield of 25.05 md. per acre as against 12.90 md. for the control. There was also a considerable in-

crease in the yield of fibre due to an application of nitrogen either alone or in combination with potash or with phosphorus. In acid zone, the highest yield of 16 mds. was obtained from application of 20 lb. N and 6 mds. of lime per acre.

West Bengal.—Out of 30 trials scheduled 19 trials were successfully conducted. Application of 20 lb. N alone gave on an average 19.30 mds. fibre but highest yield was obtained from 30 lb. N in combination with 30 lb. P_2O_5 and 40 lb. K_2O per acre 22.00 md. of fibre as against 15.28 md. of the control.

Assam.—Out of 30 trials originally fixed 14 were successful, application of 30 lb. N in combination with 30 lb. P_2O_5 or 40 lb. K_2O or both enhanced the yield of fibre considerably by 12 and 16 mds. in *olitorius* and *capsularis* respectively as against 8 and 9 mds. for the controls. On an average an extra yield of 4 to 6 mds. of fibre was obtaiied by application of fertilizers as mentioned above.

Orissa.—Twenty five trials were conducted as per schedule of which 9 trials failed. The effects of the fertilizers were not very marked in case of *capsularis* jute, the highest yield being 22 mds. per acre as against 19 mds. for control. In *olitorius* 30 lb. N either with P or K or both increased the yield of fibre considerably giving 21.5 mds. per acre as against 16 mds. for the control.

U.P.—Out of 25 trials scheduled, 9 were successful. Highest yield of 16.02 mds. of fibre per acre was recorded from an application of 30 lb. N together with 30 lb. P_2O_5 as against 10.3 mds. of the control in *capsularis*. In the case of *olitorius* the highest yield was obtained from the application of 30 lb. N together with P and K combined.

Growing jute as a row crop

To find out the economics of growing jute as a row crop two trials, one with *capsularis* jute and the other with *olitorius* were carried out in randomized block layout. The treatments included broadcast (control), light thinning × 12″, 2″ × 12″ (2″ between plants and 12″ between rows), 3″ × 12″ (3″ between

plants and 12″ between rows) and another 3″ × 12″ (plots hand weeded like broadcast plots). For line plots the sowings were done with a hand-pushed jute seed drill. The varieties used were D154 for *capsularis* and C.G. for *olitorius*.

The crop in the two trials especially the *olitorius* was greatly affected by semilooper and white ants which resulted in the loss of fibre yield to some extent. From the statistical analysis of data it was observed that in *capsularis*, the treatment effect was significant at 5 p.c. level. The four treatments of line sowing were all found to be superior to the traditional broadcast method, but there was no significant difference among the various line sowing treatments. The treatment 3″ × 12″ gave 23.12 mds. per acre as against 18.42 mds. for the broadcast, *i.e.*, nearly 26 p.c. increase in fibre yield.

In case of *olitorius* the treatment light thinning × 12″ proved significantly superior to broadcast sowing giving 18.78 mds. per acre as against 16.09 mds. for the broadcast, *i.e.*, 16 per cent increase in fibre yield. In both *capsularis* and *olitorius* the seed rate required in line plots was nearly 50 per cent less and there was a considerable decrease in the cost of production as compared to the broadcast plots.

TABLE X

Table on yield on fibre and per cent yield on control:

Treatments	*Yield in md. per acre*	*Percent on Control*
Capsularis (D154)		
1. 3″ × 12″	23.12	125.52
2. 3″ × 12″ (hand weeded) ...	22.71	123.30
3. 2″ × 12″	22.03	119.60
4. Light thinning × 12″ ...	21.71	117.86
5. Broadcast	18.42	100.00
C. D. at 5% ...	2.75	—

Olitorius (C.G.)

1.	Light thinning × 12″ ...	18.78	116.72
2.	3″ × 12″ (hand weeded) ...	18.55	115.29
3.	3″ × 12″	17.40	108.14
4.	2″ × 12″	16.39	101.86
5.	Broadcast	16.09	100.00
	C. D. at 1% ...	1.95	—

Date of sowing experiment with C. capsularis and C. olitorius

To study (*a*) the effect of different sowing dates on yield and quality of fibre and (*b*) also the behaviour of different verieties when sown on different dates under Nilganj conditions, two trials one with *capsularis* and the other with *olitorius* were laid out for the third year.

The treatments included six dates of sowing at an interval of 20 days commencing from the 16th March. Fanduk (early) and D154 (late) in case of *capsularis* and C.G. (early) and JRO-632 (late) in case of *olitorius* were included in the trials. For want of rain first four sowings were done with irrigation in both *capsularis* and *olitorius*. The *olitorius* crop was damaged by white ants to some extent.

From the statistical analysis of data it was revealed that for *capsularis* the effects due to date of sowing and varieties were significant at 1 p.c. level. It was found that three dates of sowing *viz.*, 15-5-55, 25-4-55 and 5-4-55 belonged to the highest yielding group at 1 p.c. level. The highest mean yields obtained were 27.97 and 27.64 md. per acre from treatments sown on 15-5-55 and 25-4-55 respectively. Further it was noted that D154 was significantly superior to Fanduk at 1 p.c. level of significance.

In case of *olitorius*, it was found that both the effects *viz.*, 'date of sowing' and 'varieties' were statistically significant at 1 p.c. level and that due to interaction (date of sowing and variety) was significant at 5 p.c. level. This revealed that there existed real difference in the yields of fibre due to different 'dates of sowing' and 'varieties'. The highest mean yield of 24.30 md. per acre was obtained from second date of sowing.

Treatment sown on 5-4-55, 25-4-55 and 15-5-55 belonged to the highest critical group at 1 p.c. level. Sowing done either earlier than 5-4-55 or later than middle of May were found to be significantly inferior to April and middle of May sowings. Late variety JRO-632 was significantly superior to early variety C.G.

TABLE XI

Data on mean yield of fibre on various dates of sowing for both *Capsularis* and *olitorius* trials are shown in table below:

Treatments	*Yield in md/acre*	
Dates of sowing (whole plot)	*Capsularis*	*Olitorius*
16-3-55 (S_1) ...	19.65	9.76
5-4-55 (S_2) ...	25.08	24.03
25-4-55 (S_3) ...	27.64	22.13
15-5-55 (S_4) ...	27.97	21.09
4-6-55 (S_5) ...	18.33	17.48
24-6-55 (S_6) ...	6.32	9.30
C.D. at 1% ...	5.54	4.70

Varieties (sub-plot)		*Varieties (sub-plot)*	
D154 ...	21.72	JRO-632	20.12
Fanduk ...	19.95	C.G.	14.12
C.D. at 1%	1.45	C.D. at 1%	3.47

Enquiry into cost of cultivation

A preliminary enquiry for the study of the cost of cultivation of jute crop along with the main food crop, paddy, was undertaken in the 7 centres under the Extension work *viz.*, Amdanga, Baduria, Barasat, Basirhat, Habra, Nilganj East and Nilganj West. The scope of the enquiry was limited within the jute growers who possessed jute and paddy land. From the observations taken by the field staff of the Extension centres during and after the crop seasons, detailed informations were collected and the factors affecting the cost of cultivation of jute and paddy were studied.

The man days employed for different operational stages in the cultivation of jute crop were worked out and the per-

centages of the total human labour employed per acre for the operational stages viz., ploughing-laddering, manuring, sowing, harrowing-raking, weeding-thinning, harvesting, steeping-carrying, washing-tripping, drying-bundling and plant protection measure (viz., dusting, spraying etc.) were calculated to be as 13.1, 6.2, 2.0, 3.7, 28.8, 9.7, 12.1, 17.7, 6.0 and 0.7 respectively. The maximum human labour was consumed for weeding-thinning operations. The average operational cost for the cultivation of jute including cost of seed, manures, fertilizers and insecticides was estimated to be Rs. 218/- although the range of variation is considerably high depending on economic, topographic and climatic factors. The percentages of the total operational cost for human-labour, cattle-labour, manure and seed were respectively 79, 10, 8 and 3. Again the percentage distribution of the labour supply from the family and hired sources was noted to be 52 and 48 in case of the human labour, and 72 and 28 in case of the cattle labour. The hired human labour was mostly required in weeding-thinning, washing-stripping, steeping-carrying and harvesting.

Similar enquiry was also made to estimate the average cost of cultivation of the main food crop *viz.*, paddy. The percentages of the total human labour employed per acre of paddy land for the operations namely, preparation and care of seed bed, ploughing-laddering, manuring, uprooting of seedlings and transplanting, weeding-thinning, harvesting, carrying-bundling and thrashing-winnowing-storing were calculated to be 2.7, 22.3, 3.0, 20.8, 13.1, 16.8, 7.8 and 13.5 respectively. The maximum labour was employed for ploughing-laddering and transplanting operations. The average operational cost for the cultivation of paddy, which had a very high range of variation worked out approximately to be Rs. 119/- per acre. The percentages of this total cost expended for human labour, cattle labour, manures and seed were respectively 68, 19, 7 and 6. The percentage distribution of labour supply from family and hired sources was found to be 68 and 32 in case of human labour and 83 and 17 in case of cattle labour. The hired human labour is mostly required in stages of transplanting, weeding and harvesting.

The average values of by-products obtained per acre from jute and paddy were estimated to be roughly Rs. 18/- and Rs. 32/- respectively. The average cash rent of cultivable land was nearly Rs. 7/- per acre. The comparative study of the cost of cultivating jute and paddy is now available.

Particulars	*Cost per acre (Rs.)* *Jute*	*Paddy*
Operational cost	218/-	119/-
Rent (cash)	7/-	7/-
Total cost of cultivation ...	225/-	126/-
(—) By products	18/-	32/-
(—) Family Labour (Human and cattle) ...	105/-	74/-
Paid operational cost ...	102/-	20/-

The paid operational costs for jute and paddy worked out approximately to Rs. 102/- and Rs. 20/- per acre respectively. The average yields of jute and paddy per acre were estimated to be nearly 16 maunds and 18 maunds respectively. Therefore, the average cost of cultivation of jute and paddy per maund were calculated to be Rs. 14/2/- and Rs. 7/- respectively. The average market prices for jute and paddy were observed during the period under study to be Rs. 25/3/- and Rs. 10/8/- respectively. Thus the profits per maund from jute and paddy were Rs. 11/1/- and Rs. 3/8/- respectively. The profit derived from the cultivation of the cash crop was nearly 3.2 times that from the main food crop.

GREEN MANURING

Short summary of work done last year.

Thirtyseven different types of seeds were collected for the purpose and were maintained. So far 'dhaincha', cowpea, and sunnhemp gave good results while 'kalai', 'kalikalai' and 'pillipesera' showed some promise. Under Nilganj conditions, green manuring either alone or in conjunction with fertilizers did not have better effects than by direct use of fertilizers in

regard to yield of paddy. Of the green manuring crops sown between standing jute rows cowpea gave better result than 'dhaincha', so far as the yield of paddy was concerned. Cowpea between jute-rows proved equally good as 'dhaincha' and cowpea when grown alone. In case of wheat the highest yield of 25.4 maund per acre was obtained when the crop was green manured with early sown cowpea. Of the green manure crops sown in jute rows cowpea gave better result than 'dhaincha'. Highest yield of paddy was obtained with green manuring with cowpea. The treatments, green manuring with 'dhaincha', application of F.Y.M., compost, sludge and oil-cakes were also found to be significantly superior to the control.

With a view to study the effect of green manuring on the yield of jute or paddy or on both under West Bengal conditions, a model scheme of the I.C.A.R. on the improvement of green manuring crops sanctioned for a period of 5 years was taken up in 1953-54. The aim of the scheme is to study the agronomical aspects of the green manuring crops. The following studies were undertaken during the year under report.

1. *Maintenance and observation of species and varieties of green manuring crops.*—Thirty five varieties of green manure crops were grown in type plots during the year under report. Of the varieties Sunnhemp (*Crotalaria juncea*), 'Dhaincha' (*Sesbania aculeata*), 'Kalikalai' (*Phaseolus mungo*), Cowpea (*Vigna catjang*), Groundnut (*Arachis hypogea*), Soyabean (*Soja max*), Sun flower (*Helianthus annuus*), 'Hati mung' (*Phaseolus sp.*), 'Dhaincha'—Madras (*Seshbania paludosa*) Buffalo grass (*Reana luxurians*), Sunnhemp, black Assam (*Tephrosia candida*) gave promising performance so far as vegetative growth and habits were concerned. Observation on the quantity of green matter produced by the above crops will be taken up next year.

2. *Observation on yield of types found promising and study of their incorporation (period) on yield of paddy.*—Green manuring crops like *P. mungo, C. juncea* and *P. trilobus* were studied as against *V. catjang, S. aculeata*. A fallow paddy plot was also kept for comparative study. Six weeks old green manuring crops were incorporated and allowed to decompose for 30, 20

and 10 days followed by paddy. Of the green manuring crops *C. juncea* gave the highest yield of green matter followed by *V. catjang* and *P. mungo*. The green manuring crops when allowed to rot between 10-20 days were found to give comparative higher yield of paddy. Highest yield of paddy was obtained from *P. mungo* when it was allowed to decompose for 20 days.

3. *Preliminary studies on the possibilities of growing various green manuring crops in relation to its time of sowing between standing jute rows of different widths and crop (jute) ages*.—The green manuring crops were sown when jute was 35 and 55 days old. *S. aculeata, C. juncea, P. mungo, V. catjang* and *P. trilobus* when sown early tended to grow somewhat better between 18″ and 24″ jute rows, but the green matter produced was very little.

4. *Study of comparative efficacy of green manures alone or in conjunction with fertilizers on the yield of paddy*.—The treatments included 2 green manuring crops, *S. aculeata* and *V. catjang* with or without fertilizer followed by paddy. A mixture of ammonium sulphate, single superphosphate and muriate of potash was applied thus providing 20 lbs. N, 60 lbs. P_2O_5 and 25 lbs. K_2O per acre. Application of fertilizer mixture was done to (*a*) green manuring crops direct, (*b*) green manuring crops at the time of incorporation and (*c*) paddy direct. One treatment with paddy alone without green manuring crops or fertilizers and another treatment with jute followed by paddy with or without fertilizer mixture were also included in the trial. Like previous year highest yield was obtained when fertilizer mixture was added to paddy direct. Green manuring alone or in conjunction with fertilizer did not show any better response than fertilizing paddy direct.

5. *Study of the optimum date of sowing and age of green manuring crops for incorporation when sown alone or inter-cropped with jute in relation to yield of paddy*.—The treatments included two dates of sowing of *P. mungo* and *C. juncea* at an interval of 20 days and they were harvested at varying ages—35 and 55 days. Green manuring crops were sown either alone or inter-cropped with *capsularis* jute followed by paddy. The treatments paddy alone and paddy after jute were also included

in the experiment besides a treatment in which jute tops, leaves etc. were incorporated after the harvest of jute followed by paddy.

In the previous year cowpea and 'Dhaincha' were tried as green manuring crops. Due to trailing habit of cowpea great inconvenience was felt at the time of jute harvest when cowpea was intercropped with jute last year. 'Dhaincha' was also seriously attacked by a pest which is also a common pest for jute also. Therefore, the two green manuring crops, Dhaincha and cowpea were replaced by 'kalikalai' and sunnhemp this year.

P. mungo when sown alone (1st date) gave equally good result as that of *C. juncea* so far as the green matter is concerned. But when sown on 2nd date, it gave higher yield of green matter than *C. juncea*. Of the green manuring crops sown between standing jute rows *P. mungo* gave comparatively better performance but the green matter produced was poor. Green manuring alone or inter-cropped with jute gave equally good result so far as yield of paddy is concerned.

6. *Study of the optimum date of sowing and age of the green manuring crops for incorporation when sown alone or inter-cropped with jute in relation to the yield of wheat.*—The treatments included two dates of sowing of *P. mungo* and *C. juncea* at an interval of 20 days commencing from 11th July, 1955. As in item no 5, here also cowpea and 'Dhaincha' were replaced by 'kalikalai' and sunnhemp for the same reason. The green manuring crops were sown either alone or inter-cropped with *olitorius* jute followed by wheat. The treatments, wheat alone and wheat after jute were also included in the trial besides the treatment in which jute tops, leaves etc. were incorporated into the soil after the harvest of jute followed by wheat.

Of the green manuring crops, sunnhemp and 'kalikalai' when sown alone gave equally good yield of green matter. *C. juncea* proved better than *P. mungo* when sown between standing jute rows but the yield of green matter was very poor. 'Kalikalai' and sunnhemp when sown either alone or inter-cropped with jute gave 9 to 11 mds. extra yield of wheat as against control.

7. *Study of the effect of green manures, and other manures (both organic and inorganic) on the yield of paddy.*—To study the comparative effects of different green manures and other manures on the yield of paddy a trial was conducted at Nilganj. The treatments included fertilizers, oilcake, F.Y.M., compost, sludge (at 20 lb. available N per acre) along with two green manuring crops, Dhaincha (*S. aculeata*) and cowpea (*V. catjang*). Dhaincha and cowpea were incorporated in the soil with or without lime (200 lb./acre) with regard to fertilizers, ammonium sulphate, single superphosphate and muriate of potash was applied @ 20 lbs. N, 60 lbs. P_2O_5 and 25 lbs K_2O per acre.

Highest yield of paddy (32 mds./acre) was obtained by the application of compost. This was closely followed by sludge and F.Y.M. Green manuring (cowpea and Dhaincha) with or without lime did not show any beneficial effect on the yield of paddy.

VI. SOIL, BIOCHEMICAL AND MICROBIOLOGICAL STUDIES

Short summary of work done last year.

No marked difference in soil properties were found in soils where jute alone was cultivated for 3 years in succession. In double-cropped areas where jute was used as a preceding crop the soils were in a better state of fertility. Soil nitrogen has been found to increase after cultivation of jute. The changes in soils where heavy doses of fertilizers were used were studied. The sequence of change of soil micro-organisms were similar in plots receiving nitrogen from different organic and inorganic sources. The important finding regarding soil phosphorus was that available phosphorus increased after a crop of jute. Plants, within a limit, took up more nitrogen when more nitrogenous fertilizers were used. Work on the role of different trace elements like boron, zinc, molybdenum etc. in relation to incidence of diseases was carried out. Under Barrackpore conditions it was found that Krilium and tamarind seed powder improved water retention capacity of soil.

Work on the standardization of the rapid methods for estimating available nitrogen and phosphates were continued.

The role of pH along with iron and tannic acid was investigated in relation to the formation of 'shamla' colour. In the study on improvement of coloration of fibre it was found that the 'shamla' colour could be removed by tamarind extracts at a cost of annas ten per maund of fibre. Investigation in retting processes under laboratory conditions showed that introduction of leguminous plants like 'dhaincha' or 'sunnhemp' or some trace elements at certain concentrations reduced the retting period.

Possibilities of retting without steeping was explored with help of different micro-organisms; fibres from such retting were not uniform but coarse and barky. The work of isolation and maintenance of several micro-organisms were continued. with a view to study the activity of the enzymes of the promising cultures on pectins and hemicelluloses.

Soils

As the work in connection with the necessary fittings for gas and water supply to the laboratories has not yet been completed, no detailed chemical work could be done. Only field trials and pot culture experiments were carried out.

Soil exhaustion studies.—(*A*) *Soil exhaustion studies in double-cropping plots.*—Both in pots and in a test trial in the field, the effect of growing jute on the succeeding crop of wheat was studied. It was found that the yield of wheat is not adversely affected by growing jute as a preceding crop provided the recommended practice of adding leaves and other non-fibre producing materials are added back to the soil.

(*B*) *Soil exhaustion by different varieties of jute.*—During the period under report, the old plots were bulldozed and a new trial has been started with JRC-212, D154 and Fanduk (*capsularis*) and JRO-632, JRO-620 and C.G. (*olitorius*) to study the differential exhaustion of the soil.

(C) Changes in the nutrient status of the soils: *(a) In heavily fertilised fields*.—Three different new experiments have been started during the period under report. The treatments in the first experiment are different doses of ammonium sulphate to be added each year with the pH and lime-status adjusted to original every year before sowing, in the second experiment different doses of super-phosphate having nitrogen in different rates from ammonium sulphate and in the third, different doses of nitrogen split into different ratios of inorganic and organic sources. The yield results showed some interesting features but for want of gas and water no laboratory work could be carried out.

(b) Soil nitrogen: *(i) Chemical*.—No work could be done.

(ii) Microbiological—Azotobacter were found to be comparatively in larger number in phosphate treated and jute cropped plots. Two species of *Azotobacter*, one strain of *A. chrocoocum* (Black strain) and another strain of *A. indicum* have been isolated and their effect on the jute crop is being studied.

(c) Soil phosphorus.—The pot culture work with different types of soils were continued and the results are similar to those of previous years. A new experiment with different phosphates as source of phosphates has also been started. It may be stated that some responses to basic slag only has been observed.

(D) Withdrawal of nutrients by the jute plants.—Only inorganic ions in the shoot apex could be estimated and the results are similar to previous years.

Development of Methods for Determination of Nutrients for Advisory Work in Connection with Manuring etc.—Both laboratory scale work and pot culture work are being carried out to develop a suitable quick and reliable method for nitrogen in soils for jute.

Role of soil conditions regarding susceptibility to diseases.—As the site of the plots had to be changed, due to bull-dozing, practically no differential effect was observed : this year being the first year of experiment at a new site, B, Zn, Cu, Mn, Co,

Mo, Va, Mg from different sources were used at different dosages. It may, however, be mentioned that molybdenum and copper show some beneficial effect.

Attempts to find out the maximum production of jute under the influence of nitrogen.—It has been found that with heavy application of nitrogenous fertilisers especially ammonium sulphate, the yield per plant though increases proportionately, but due to loss of plants due to diseases yield per acre does not increase with progressive increase beyond a certain limit depending on several factors, this limiting dose varies from 60 to 100 lb. of nitrogen but along with phosphates or with organic sources, the dose of nitrogen may be increased profitably with consequent increase in the fibre yield.

The influence of soil conditioners on soil texture.—It has been found that as already observed in Nilganj soil (sandy loam), Krilium and tamarind kernel powder increase the water-holding capacity in the heavy clay soil of Chinsurah in pot culture experiments, whilst compost, ammonium sulphate and silicates have practically no effect.

Analysis of soils and manures for their chemical and mechanical constituents.—Except determination of pH and available nutrients in some cases no work could be done.

Quality of Fibre

Colouration of fibre.—Besides the concentration of tannic acid and iron, ascribed to be the cause of *shamla* colour, the pH of the retting water plays an important part in imparting the colour to the fibres. The nature of other cations and anions also to a certain extent influence the colour. The exact pH at which the maximum coloration occurs depends on the amount of tannin present in the fibres and the iron content of the water as also on other cations and anions, yet it can be tentatively stated that if the pH is from slightly acidic (6.4) to neutral range, the coloration is less.

It was reported last year that a treatment with 2 per cent tamarind extract for a period of 5 minutes is sufficient to remove the *shamla* colour and the operation costs about -/10/- (ten

annas) per maund including the cost of labour @ Rs. 1/10/- per day. The technological tests have revealed that quality ratio of the fibre after tamarind extract treatment become higher. Green tamarind extract was also found to be effective in improving the colour, but quality ratio become somewhat lower. Removal of *shyamla* colour from the dry fibre takes much longer time and the residual effect of tamarind extract is much less, and cost, therefore, becomes much higher.

Work was continued with different varieties of jute to study their tannin absorption and retention capacities at different pH values.

Edaphic factors.—The quality ratio test reports, of the samples of fibres from plants grown at Kendrapara (Orissa), Manoharpur (Hooghly, West Bengal), Gothmilki (Purnea, Bihar), Belakoba (Jalpaiguri, W. Bengal), Tomkohi Road (U.P.) retted and extracted under Barrackpore conditions in 1954, show that the quality ratio of the plants grown at Manoharpur, Belakoba and Tomkohi Road which are richer in available phosphate, are better than that of fibre samples obtained from plants grown at other places, of which the samples from Manoharpur were the best, which was also richest in available phosphate.

During the period under report, green jute stems obtained from Purnea (Bihar), Belakoba and Manoharpur (W. Bengal), Kendrapara (Orissa) were retted and fibres extracted under Barrackpore conditions. Samples were sent for technological tests and the results are similar to previous years.

Quality ratio of fibre samples, obtained from an experiment where dose of phosphatic fertilisers were kept fixed and the quantity of nitrogenous fertilisers was varied at different fixed ratios and retted and extracted under controlled conditions falls usually with increase in the proportion of nitrogen. The C.V. percentage increases with increase in nitrogen and strength of the fibre decreases with increase in nitrogen.

Retting of Jute

(*a*) *Action of different activators on retting of jute*.—The experiment was continued in controlled retting tanks with differ-

ent varieties of jute with bone dust and ammonium sulphate both added at the rate of 2 gm. per litre of retting water in combination. It was found that the treatment is effective in lowering the period of retting and particularly so when the temperature was lower.

Plants of same base diameter grown in plots where nitrogenous and phosphatic fertilisers were added in combination require usually shorter time for retting than where no fertilisers were added. It has also been noted that where nitrogenous fertilisers alone are added, the time taken for retting is usually slightly shorter, whilst in case of phosphatic fertilisers time taken is slightly longer.

It has already been reported that when sunnhemp or *dhaincha* stems are put in the bundles of jute, the time taken for retting is shorter. The experiments were continued in controlled retting tanks along with bone dust and ammonium sulphate. It was found that sunnhemp alone or with bone dust reduced the retting period most and the period taken was less than the period taken by ammonium sulphate and bone dust in combination, whilst the retting period with *dhaincha* alone or with bone dust is of the same order as that of ammonium sulphate and bone dust.

Of the several trace elements and complex salts studied, this year also potassium persulphate at 1 p.p.m. concentration gave the best result and the behaviour of other salts were somewhat irregular.

(*b*) *Survey of retting water*.—32 samples of retting water collected from Nilgunj, Barasat, Basirhat and Tarakeswar areas in West Bengal to study their chemical constituents as well as the micro-organisms. Dissolved oxygen, pH, phenolpthalein alkalinity, methyl orange acidity, water soluble inorganic phosphorus, nitrate-nitrogen, ammoniacal-nitrogen, ferrous and ferric iron etc., wrere estimated. The data obtained this year are similar to those of previous years. Retting water which usually contain 5 to 6 p.p.m. of available nitrogen and after soluble phosphates of the order of 100 p.p.m. may be utilised as manure. It has been observed that the growth of paddy is

better in fields where retting water enters. Further work on the role of retting water as manure will be taken up during the next season.

(*c*) *Retting without steeping.*—It was reported that though fibre can be obtained by 'stack retting', but the quality of fibre is very bad. Attempts were made to improve the fibre quality and some progress has been made.

(*d*) *Biochemical changes during retting.*—It has already been reported that not only pectins but also hemi-celluloses are the materials between the cells constituting the soft tissues in between the fibre bundles, which break down during retting. By solvent extraction, pure samples of these products have been obtained and the effect of different micro-organisms isolated from retting water on their decomposition is under study.

Temperature is a very important factor in retting and variation of temperature considerably affects the retting period. It has been found that a temperature of 34 to 35°C is the optimum. Rate of increase of retting period with difference of temperature is more in the higher side than in the lower side of the optimum. The rate of formation of reducing sugars as the end product of the decomposition in retting at different temperatures and at different pH are being studied.

(*e*) *Isolation and purification of micro-organisms.*—Amongst the cultures isolated, only five strains of bacteria and 11 strains of fungi have been found to possess the retting properties. It has also been found that many cultures lost their capability to ret when sub-cultured several times in nutrient media.

VII. DISEASES

Short summary of work done last year.

Study of the incidence of diseases indicated that under Nilgunj conditions late sowing is preferable. The secondary spread of the fungus could be effectively checked by fungicidal sprays before and immediately after heavy showers. A comparative study of the different isolates of the stem-rot

fungus from different places indicated that they differed in pathogenicity. This indicates that resistant types of jute are to be developed on regional basis. The epidemic root-rot in the jute-potato fields had been under study for the four years ; it was found that the disease due to *Macrophomina phaseoli* increased in presence of the *Pseudomonas* sp. and *Fusarium solani,* the usual soil inhabitants in potato fields. The latter played an important role as secondary pathogens.

Anthracnose of jute, a disease first observed in Japan, was found to attack some newly evolved types and indigenous strains. The fungus was studied. Exclusion of susceptible types were in progress.

Tetraploid materials from both *capsularis* and *olitorius* types were susceptible to a physiological disease known as 'scalding'. Some types suffered from chlorosis, due to lack of nutrients. Further evidences for the virus nature of the seed borne 'chlorosis' were collected.

Selection of types resistant to stem-rot and root-rot were in progress. Grading the different jute varieties according to susceptibility was undertaken.

'Alkathene' lined gunny bags have been found to be best containers for storing jute seeds. Well-stored seeds could be utilised for cropping even in the third season following harvest.

Study of the Effects of Environmental Factors on Secondary Infection due to Macrophomina phaseoli

A comparative study of the stomata of JRC-412, a variety highly susceptible to secondary infection due to pycnospores and those of D154, a comparatively less susceptible variety, in relation to the germ tubes and hyphae was made. No significant relationship was found. It was also found that the fungus could penetrate the leaf tissue through extra-stomatal spaces of the epidermis.

C. olitorius normally does not suffer from stem-rot in the alluvial areas in eastern parts of West Bengal, while it suffers heavily in the sandy-loam tracts of the western parts of the state.

In water-logged areas the growth of the plants is arrested ; such stunted plants are mostly attacked with pycnospores. The humidity, during the incubation period was found to be above 85 per cent on average, while the temperature was 80°F on average.

Study of the Stem-rot Fungus

(i) The study of the pathogenicity of the strains B46, B43, and B45 singly and in combination from *Fusarium* sp. and *Pseudomonas* sp., previously isolated from wilted jute, was carried out under field conditions against *C. olitorius* plants of normal growth. All the three strains of *Rhizoctonia bataticola* failed to induce wilt during the month of June when used singly, symptoms appeared only in the last week of August. While the two strains B46 and B43 in combination with *Fusarium* sp. and *Pseudomonas* sp. readily infected the plants and the symptoms were evident in the second week of July, B45 did not prove a virulent pathogen on jute. The influence of *Fusarium* sp. and bacteria are increasingly becoming evident so far jute-potato fields are concerned. The experiment was conducted in pots for want of a green house.

(*ii*) While studying the comparative pathogenic properties of the eight forms of *Rhizoctonia bataticola* isolated from different jute growing tracts, it was observed that soil temperature was an important determinant in inducing infection from soil. At a temperature of 100°F of the soil at 5 cm. depth the fungus was more active as a pathogen than at lower temperatures. B45 and B35 proved comparatively less virulent than B43 and B46. B50 was found to give erratic results.

Other Disease

(*i*) *Anthracnose of jute*.—Mass selection from the progeny of the last year's 3 selections which proved to be fairly resistant, was made and would be maintained for yield studies.

Effect of Perecot, T.M.T.D., Landisan and Agrosan GN on the seed-borne *Colletotrichum* sp. on jute was studied both under laboratory and field conditions.

TABLE XII

Showing comparative efficacy of commercial fungicides against seed borne Colletotrichum sp. on jute

Fungicide	*Treatment time (minutes)*	*Seeds showing fungus mean per cent*
Perecot	... 10	3.05
-do-	... 30	1.92
-do-	... 40	0.85
T.M.T.D.	... 10	0.93
-do-	... 30	0.31
-do-	... 60	0.11
Landisan	... 10	0.88
-do-	... 30	0.43
-do-	... 60	0.08
Agrosan GN	... 30	0.00
-do-	... 60	0.00
Control	... ...	9.04
P	... 0.01	
C.D.	... 0.89	
S.E.%	... 15.99	

Agrosan GN proved to be more efficient than others under same conditions. Field data did not show any significant difference in the degree of seedling mortality, particularly because pre-emergence rots could not be taken into account. Seed treatment, however, gives little protection against air borne conidia.

The species of *Colletotrichum* isolated from seed, seedling, mature stem and pods of indigenous types of jute plants from Nilganj was found to be closely related to the Malayan species and Japanese species isolated from jute, although there were small differences in morphological characters. The Japanese form described by Ikata and Tanaka has a patelli-form stroma 100-300 μ long, 25-50 μ high, while the Indian form on jute has a subglobose to hemispherical, sometimes lenticular stroma, 130-380 μ long, 30.35 μ high. The Malayan form is closely similar to the Indian form. *C. capsici* (Syd.) Butl. and Bisby has a hemispherical stroma 70-120 μ . There are 5-15 or several setae in the Japanese form having 2-5 septa, 36-117 μ long, 3.6—5.0 μ at the base. In the Indian and the Malayan form the corresponding figures are 10—30, mostly

20—30 μ, septa 2—5, 32—138 μ long, 3.9—5.2 μ broad at the base. In *C. capsici* (Syd.) Butl. and Bisby it is 150 μ long; other details are lacking. Conidia in the three Japanese forms are falcate fusoid to oblong-fusoid, 12—25 μ × 3.6 × 6.0 μ, in the Indian form they are falcate, 17—24 × 2.6—3.25 μ while in *C. capsici* it is 17—28 μ × 3—4 μ. Both the Indian form on jute and *C. capsici* have spores which are pinkish in mass.

It now seems that the Indian form of *Colletotrichum* on jute and those found on jute in Japan and Malaya belong to the same group. Whether these are strains of *C. capsici* (Syd.) Butl. & Bisby or belong to a new species as Ikata and Tanaka have described remains to be studied.

(*ii*) *Ozonium sp. on jute.*—A species of *Ozonium* was found associated with seedling blight and collar-rot of jute in the light soil areas of West Bengal. Experiments have showed that it was a virulent pathogen on jute. Mortality of the seedlings of *C. olitorius* was cent per cent due to the fungus artificially grown on P.D.A. *Cassia occidentalis*, a common weed was found to be an alternate host prevalent in jute fields. The fungus was rarely found in clay soils. Two strains were recognised, one deep brown and the other greyish brown. The deep brown strain was also obtained from infected seedlings of *H. cannabinus* (Kenaf or mesta) and *H. sabdariffa* (roselle) from Nilganj. It is a quick growing fungus often found associated with *Rhizoctonia* in infected plants both jute and mesta.

(*iii*) *Wilt of jute.—Fusarium solani* Kuhn (?) and *Pseudomonas* sp. proved non-pathogenic singly, but they produced the well known symptoms of wilt when used along with the *Rhizoctonia* and *Ozonium* isolated from Tarakeswar area. *Rhizoctonia* alone was slow to infect and symptoms produced by *Rhizoctonia* alone were different from the typical wilt symptoms seen in jute-potato fields.

(*iv*) *Soft-rot caused by Sclerotium rolfsii Sacc.*—The general incidence was low in both *C. capsularis* and *C. olitorius*. Sclerotia raised in artificial culture failed to infect jute, parti-

cularly due to antagonistic effects of actinomycetes which attacked sclerotia under field conditions.

(*v*) *Curvularia subulata* (Nees) Boedijn. was regularly found along with a species of *Alternaria* in a type of new disease, which affected JRC-212 in the second week of May, when the crop was one and half months old. *C. lunata* (Walker) Boedijn is sometimes found associated with various types of cankers in jute stem.

Helminthosporium sp. (*teres* Sacc. ?) and *Nigrospora* sp. was found in association with *Curvularia* sp. and *Colletotrichum* sp. in some *C. olitorius* plants having heavy rotting of leaf.

Chlorosis in Jute.—Further attempts to induce chlorosis in variety D154 and JRC-321 by smears did not prove successful.

Investigations on the Method of Control of Diseases

(*i*) *Selection and breeding resistant types.*—Variety JRC-412 proved to be a high yielding and early maturing one. But from the results of the subvention trials it was found that the variety was susceptible to stem-rot and later to anthracnose as well. D154, a high yielding late type and relatively resistant to stem-rot, was found to be somewhat resistant to anthracnose. With a view to combine the desirable characters of the two, crosses were made between JRC-412 and D154. The F_1s and the parents were grown in plots heavily inoculated with different strains of *Rhizoctonia bataticola* (Taub), *viz.*, strain Nos. B43, B46 and B68. The performance with regard to disease resistance of the F_1s resembled D154 to a great extent. Pre-emergence rot could not be taken into account. 60 pods were obtained from successful back cross and fresh parental crosses. Selection in the F_1s were made for study next season.

26 strains of *C. capsularis* were grown in artificially inoculated plots. The plants were kept under observation throughout the season and were graded according to the degree and nature of damage suffered by the plants and also according to percentage of plants affected. These materials are being studied to find out their range of resistance. The wild *capsularis* types from Magra was found to be highly susceptible under Nilganj conditions.

Of the several *C. olitorius* types grown in a sick plot well known for root-rot, the 'wild green' and a selection from a cross between 'wild green' and JRO-632 proved comparatively resistant to early root-rot. But in both the cases germination was very poor. The symptoms due to *Macrophomina phaseoli* (Maubl.) Ashby have been classified into seven categories, in order to facilitate grading resistance of different varieties. The classification was based on the number of necrotic spots, extent of damage due to such necrosis and location of necrosis.

Similar classification was made with regard to infection due to *Colletotrichum*.

The work of selection and breeding under field conditions became difficult due to mixed infection of *M. phaseoli* and *Colletotrichum* sp. However, 48 selections from branching and 11 selections from non-branching *capsularis* types were tested in replicated randomised plots against infections of *M. phaseoli* and *Colletotrichum* sp. To ensure secondary leaf infection a border crop of JRC-412 was grown which was found to have abundant leaf infection. Selections were made for further studies. Non-branching types were in general more susceptible than branching types. Most of the exotic types from the Far East were found to be particularly susceptible to anthracnose.

(*ii*) *Susceptibility of different varieties to diseases*.—Field records of incidence of diseases in *capsularis* varietal trials, Nos. 1 and 2 show that amongst the improved strains including D154, there had been no significant difference so far as number of infected plants was concerned. Some observed differences were, however, observed with regard to the intensity of damage, for the assessment of which, a suitable method is being worked out.

The varieties JRC-212, JRC-321, JRC-322, JRC-412, Fanduk and D154 grown in different areas behaved differently with regard to their susceptibility. JRC-412 proved to be susceptible in a number of places.

It was also found under Nilganj conditions that the non-branching type JRC-918 was immune to the common diseases, but JRC-5854 was attacked with stem-rot and anthracnose.

82 genetic strains were studied and graded according to their performance in relation to diseases.

(iii) Field studies on the relative efficacy of some commercial fungicides.—A number of commercial copper fungicides in the form of oxides and oxychlorides together with thiocarbamates of zinc, sodium and manganese and Bordeaux mixture were tried under field conditions to prevent and arrest secondary attack of *Macrophomina phaseoli* and *Colletotrichum* sp. in replicated plots with JRC-412 as the host. A knapsack sprayer with a working capacity of 3.5 gallons (nett capacity 4 gallons) was used for spraying. Results indicated that the copper fungicides were effective in various degrees of which the oxide (Perenox) proved best. Of the non-copper fungicides manganese ethylene bisdithiocarbamate proved better than thiocarbamates of zinc and sodium. Lime sulphur did not prove effective. Although absolute protection has not been possible due to unavoidable errors in manipulation of the spraying operation, the fungicides showed promise against secondary infection through pycnospores of *Macrophomina phaseoli* and conidia of *Colletotrichum* sp. The differences in yield could not be correlated with the rate of infection or extent of damage. Low yield in plots treated with Dithane Z-78 was due to toxic effects on the plants.

TABLE XIII

Showing incidence of disease and yield

Treatment	Before spraying operations started. Recorded on 24-6-55	Incidence on 3-8-55 after spraying and weeding	Yield in lb.
Perenox	2.92	7.55	14.58
Colloidal copper (Ialine)	4.49	8.15	11.08
Dithane—D14	4.57	12.73	11.97
Bordeaux mixture	2.81	14.89	12.61
Agricop	4.54	15.25	13.52
Menzate	3.31	18.79	13.74
Cupravit	2.96	19.25	10.78
Shell copper fungicide	2.05	22.18	10.97
Diathane Z-78	4.81	30.70	7.06
Lime sulphur	2.35	27.71	12.48
Control	4.84	35.04	12.23
P	Large	0.01	0.01
C.D.		12.34	3.52
S.E.%	20.61	16.44	7.60

From the table it will be seen that the differences in incidence of disease before spraying was started were insignificant. On 3-8-55, after 40 days, 35.04 per cent plants were affected in plots without receiving any spray while in plots under treatment the disease was checked in various degrees.

(*iv*) *Effect of different fertilisers on the incidence of diseases.*—Field records from manurial trials conducted by the Agronomy Section showed that there was no significant difference amongst the different treatments of nitrogen, potash and phosphorus alone and in combination. In another field trial it was found that addition of lime reduced the number of death due to diseases while there was no significant difference in the incidence of diseases ; both stem-rot and anthracnose were considered when field data were collected.

(*v*) *Study of rotation.*—In the district of Hooghly it has been found that Jute-Kalai (*Phaseolus mungo*) rotation for two years reduced the incidence of root-rot. It has been further confirmed that potato cultivation in the same field has an important bearing on the incidence of root-rot in jute crops.

Grading different types of Jute according to Susceptibility

Under Nilganj conditions all varieties, strains and genetic types have been graded according to the nature of susceptibility to diseases. Altogether six classes have been recognised. Final classification would be made on the basis of three years' observations and records. Until now only one selection has proved distinctly superior to other types.

VIII. PESTS

Short summary of work done last year

Incidence of *Nupserha bicolor* ssp. *postbrunnea,* the new pest of *olitorius* jute was on increase and the variety C.G. was found to be most susceptible. Indications are that the pest prefers broadcast sown plots to those sown in lines. Further tests confirmed previous observations that *capsularis* varieties were not attacked by the pest. It was also observed that the larva

of the pest passes the winter in dormant stage encased in stem in the soil, surviving under varying depths of soil. Use of *capsularis* varieties and destruction of dormant larvae are helpful for control. Of the parasites of the pest, *Neocatolaccus* sp. was found to be very efficient under the field condition.

Pseudococcus filamentosus var. *corymbatus* was found to be another important pest causing direct damage on stem of both *capsularis* and *olitorius*. First instar nymphal stage was found to be the destructive phase while other phases of the pest were not associated with damage. The pest caused stuntedness and was responsible for inducing other structural changes in the stem.

In *Apion* resistance trial, some of the *capsularis* selections were found better while the *olitorius* selections did not show much difference from the control. In the study on the extent of removal of vegetative matters during different instars of the pest *Anomis sabulifera*, it was observed that the third larval instar was the most destructive. Observations on time/mortality/dosages of various insecticides on different instars of different pests were in progress.

Preliminary observations, taken on jute nematode, indicated that the pest preferred a soil depth 6″ below the surface. D.D. was found efficient for control.

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1. *Nupserha bicolor ssp. postbrunnea*

(*i*) *Elimination of larval diapause*.—Various factors were tried under laboratory conditions for elimination of larval diapause. Of these high humidity per cent was found necessary for elimination of the process. Experiments were carried out with eight months old diapausing larvae exposed to different levels of humidity viz., 10%, 33%, 55%, 67%, 85% and 97% at 30°C. In lower humidity levels like 10% and 33%, a high percentage of mortality was obtained. Humidity percentages like 67 or below have no effect in terminating the phase, while continued exposure to high humidity per cent like 97 can secure release from the diapause stage.

(ii) Epidemiology of the pest.—Simultaneous with the laboratory experiments, observations were also made on other factors like rainfall and soil temperature with regard to the emergence of adults under field conditions. It may be seen from the table below that the emergence of the pest is preceded by sufficient rainfall corroborating the laboratory finding that diapause stage is broken during the summar months when they come under the influence of sufficient soil moisture. From the point of view of epidemiology sufficient rainfall during the early crop season would indicate early emergence of the pest and its spread. Late rain tends to be associated with late emergence and consequently with late incidence of the pest.

TABLE XIV

Rainfall and emergence of adults during 1953, 1954 and 1955 seasons

Year	Months	Soil temp. (°C) below 5 cm.		No. of rainy days	Amount of rainfall in inches	Time of emergence
		Max.	Max.			
1953	April			2	0.07	
	May			6	3.08	
	June			19	11.94	2nd week
	July			20	11.30	
1954	April			1	1.02	
	May			7	4.39	
	June			18	9.08	2nd week
	July			21	5.02	
1955	April	46.1	22.2	5	1.61	
	May	45.0	24.4	6	1.69	
	June	43.9	27.2	15	4.76	
	July	38.3	23.9	22	15.23	2nd week

(iii) Extent of mortality of dormant larvae during the period following jute season.—It has already been determined that the dormancy or the diapause stage of the pest is passed in soil encased in small pieces of stem. Collection of dormant larvae from the field and observations made on them at periodical intervals after harvest till next jute season showed that only 5 to 6 per cent larvae die during the period leaving a huge percentage in soil awaiting favourable condition for release

from the dormancy. Under the laboratory conditions, dormancy persists for more than two years. Maximum mortality of the diapausing larvae was observed under the laboratory condition during the period from the 16th month to the 20th month after the onset of the diapause. Not a single case of release was recorded under normal laboratory conditions.

(*iv*) *Effect of raising capsularis jute along with olitorius as mixed crop on incidence.*—All the known indigenous and exotic types of *capsularis* jute have proved resistant to the adults. To study the effect of raising *capsularis* jute (D154) and *olitorius* (C.G.) in different percentages in the same plot of the same layout on incidence of the pest and to study the influence, if any, of the resistant type in retarding the incidence on susceptible *olitorius* (C.G.) by acting as a barrier crop, a field experiment was carried out.

Seeds of D154 and C.G. were mixed in different proportions before sowing as below:

A	0% C.G.	plus	100% D154
B	2% C.G.	,,	98% D154
C	5% C.G	,,	95% D154
D	10% C.G.	,,	90% D154
E	20% C.G.	,,	80% D154
F	40% C.G.	,,	60% D154
G	80% C.G.	,,	20% D154
H	100% C.G.	,,	0% D154

Results show that in treatment A where D154 was raised alone, not a single case of incidence was noted. In treatments B, C, D, E, F and G where *capsularis* and *olitorius* jute were raised in different proportions in the same plot, incidences were restricted only to *olitorius* (C.G.) jute, indicating thereby that *capsularis* (D154) is absolutely resistant though grown along with susceptible *olitorius* (C.G.) jute. Neither there was any reduction of incidence per cent in C.G. in any of these treatments which suggests that *capsularis* jute though itself resistant can not act as a barrier crop as the pest could pick up the susceptible type from plots with 98 per cent D154 and 2 per cent C.G.

(*v*) *Habitat of the pest during winter.*—The observations that the pest does not pass the winter in diapause stage within the jute stubbles left in the field but in small pieces of jute stem, reported last year, is confirmed from further observations this year.

(*vi*) *Effect of different levels of manures on the incidence of the pest.*—Observations on the incidence of the pest from the N,P,K. *olitorius* trial conducted by the Agronomy Section could not be continued beyond second month stage.

(*vii*) *Loss of fibre yield due to varying proportions of damage at two stages of growth.*—To estimate the loss of fibre yield due to varying percentages of damage done at two stages of growth, viz., 150 cm. and 175 cm. height stage, damage was inflicted artificially at the proper stage. Though soil heterogeneity tended to vitiate the result but the trend indicated that even a low percentage of damage could cause considerable decrease in yield. About 8 per cent damage done to crop of 150 cm. in height caused a decrease of four maunds approximately per acre while about 7 per cent damage to crop of 175 cm. height depressed fibre yield to the extent of about 2 maunds per acre.

(*viii*) *Parasites*: *Neocatolaccus* sp. continued to be the most important larval parasite of the pest. Attempts to multiply the pest on other host have not yet been successful. Attempts are also being made to locate the habitat of the parasite when *Nupserha* enters diapause.

Pseudococcus filamentosus var. *corymbatus*

(*i*) *Phase responsible for damage.*—Further tests were carried out to determine the phase responsible for damage. Previous year's finding that the first nymphal instar is responsible for damage is confirmed.

(*ii*) *Effect of damage on tissues.*—Further examination of normal and affected portion of attacked plants showed that there is almost $1\frac{1}{2}$ times increase in the number of cell layers

and almost two times increase in width in cortical, xylem and pith tissues of the affected portion over the normal.

Selection for resistance to Apion corchori

In a *capsularis* trial 26 selections from different varieties including some from X-irradiated and polyploid were sown keeping D154 as control. Some selections have done better than the control and have been brought forward. Some fresh selections have also been made. In the *olitorius* trial, 14 selections from different varieties including those from X-irradiated and polyploids were sown keeping C.G. as control. Some of the selections made in the previous years showed promise. The trial will be repeated.

Anomis sabulifera

Time/Dosage of DDT/Instar of A. sabulifera/Mortality relation.—Tests were carried out with three concentrations (active ingredient) of DDT viz., 0.25%, 0.5% and 0.75% against the first and the fourth instar caterpillars and the rate of mortality, and speed of kill recorded. Lower concentrations like 0.25% and 0.5% though bring 100% mortality of 1st instar caterpillars within two hours after treatment fail to do so when used against the fourth instar caterpillar. 0.75% concentration can bring 100% mortality of the 1st instar larva within one hour but five hours are required for 100% mortality of the fourth instar caterpillars under the laboratory conditions when kept exposed within the treated field.

Effect of DDT on Anomis sabulifera with reference to time of exposure and mortality.—0.75% DDT (active ingredient) and fourth instar caterpillars were selected in tests carried out to study the relationship between the time of exposure and mortality in which the time of exposure was varied from half-an-hour to five hours with 30 minutes interval in between keeping the concentration of DDT constant. With an exposure of half-an-hour no mortality was observed during the actual period under exposure though 80% kill was recorded after removal from the treated field. With other different times of exposure like,

1 hour, 1½ hours, 2 hours, 2½ hours, 3 hours, 3½ hours & 4 hours, 10%, 5%, 3%, 3%, 1%, 1%, a 1%,dn survival respectively was noted. Continuous exposure for 5 hours in the sprayed field can bring 100 per cent mortality. In treatments with 4½ hours exposure though 100% mortality was not obtained within the period of exposure there was no survival afterwards. With increase in the time of exposure, there is reduction in the period of kill with increase in the rate of mortality.

Comparative efficiency of some insecticides for control of Anomis sabulifera.—Folidol, Endrin, Dieldrin, Aldrin and DDT were tested for their comparative efficiency against third and fourth instar caterpillars of the pest. Six different concentrations of Folidol, four of each of Endrin, Dieldrin, Aldrin and three of DDT were used in the test. Folidol at a dosage level of 0.005% (active ingredient) can bring 100% mortality within two hours under the laboratory condition. 80%, 57.5%, 40% and 35% mortality was obtained within the same period by 0.03% Endrin, 0.75% DDT, 0.4% Aldrin and Dieldrin (active ingredient) respectively. Both Folidol and Endrin were found superior to DDT used as standard in the test and the cost of these insecticides at the above dosage levels is also much less than that of DDT. Folidol, however, with its high toxicity presents some difficulties for easy handling during field use. Dieldrin and Aldrin were however less effective.

Efficacy of chlorobenzilate against Hemitarsonemus latus

Different concentrations of chlorobenzilate were tested against *H. latus* keeping lime-sulphur (3:1) as standard. Chlorobenzilate was found to be much inferior to lime sulphur dust when used against this particular mite of jute.

Aldrin for control of termite

Various concentrations of Aldrin (W.P.) were tested against termites infesting roots of jute crop. Of these 0.4% strength was found to give better result both in the laboratory test and also in the field. 0.4% Aldrin when applied by injector gun in the field at a depth of 6″ below the surface reduced the termite population by 97%.

Effect of DDT in soil on plant growth and fibre yield

To study the effect of DDT that may accumulate in the field as a result of spraying operation, field trials were conducted—one with *capsularis* and the other with *olitorius* jute and the trials will be continued for at least 3 years. *Capsularis* trial has been rejected because of much soil heterogeneity. DDT was applied in various levels during pre-sowing operation. In the *olitorius* trial, DDT treated plots did not show retarded growth, on the contrary some treatments showed greater plant height and base diameter during different stages of growth periods. Records taken on root length during the early growth period upto one month stage indicate that in DDT treated plots, growth of root length tends to be retarded upto the 3rd week stage but the difference is made up during the 4th week stage.

Most of the DDT treated plots gave comparatively higher yield than control during the 1st year of the trial.

Nematode (Heterodera marioni)

Varietal difference of capsularis and olitorius jute.—To determine the varietal susceptibility, if any, amongst the different varieties under *capsularis* jute, seventeen varieties were sown in known nematode infected soil kept in separate pots. Observations showed that all these varieties are more or less susceptible and they take nematode infestation within 3 weeks from germination. Similar observations were carried out with five different *olitorius* varieties but none was found to be resistant.

JUTE PEST AND DISEASE CONTROL SCHEME, TARAKESWAR

Short summary of work done last year.

In work on the Pest and Disease Control Scheme at Tarakeswar progressed very well. Most of the control measures evolved, assessed and recommended by the Institute were found to be effective and economic under cultivators' conditions. Cultivators in the area are now conversant with the uses of various fungicides and pesticides. The problem of control of epi-

demic root-rot however could not be solved to the entire satisfaction. Efforts were made to throw more light on the problem.

An area of 274 bighas (91.3 acres) of cultivators' land was brought within the scope of the scheme. Of this about 243 bighas (81 acres) were sown with jute (*C. olitorius*). The rest was with ' Aus ' paddy, brinzal or fodder.

Sowing started on 24th May and was completed by 6th June. Starting from 22nd May till the 22nd August there were 29 rainy days, 1 on 22nd May, 14 in June, 10 July and 6 in August. Rainfall below 0.1 inches was not taken into account. The total rainfall for the period was 44 inches.

Diseases.—Ozonium sp. was universally found in the jute-potato fields. It caused seedling blight in the early stages. *Cassia occidentalis* was found to be common alternate host. The spread of the fungus, under hot and humid conditions, was very rapid.

A plot to plot survey for five years has shown that the loss due to wilt and stem-rot disease in this area was very high. Mortality usually started from second week of July and continued till harvest. Hardly any plot was found to be completely free from disease. The five-year survey has shown that the spread of the disease and loss due to disease are increasing gradually. Annual loss due to wilt and stem-rot has been estimated to be 8 to 11 per cent, while it varied from 2 to 31 per cent in different plots. In this estimate, loss in quality has not been taken into account. It has been observed that the jute from this area yields a high percentage of cuttings and 'rooty' fibre ; such cuttings and rooty fibres are often due to fibre from diseased plants.

At present it has been possible to save 2 to 5 per cent of the estimated loss in a given number of cultivators' plots by methods so far evolved at this institute, keeping the cost of such protection measures at economic level. Investigations are proceeding to evolve more effective methods with low cost.

So far the protection measures included are use of late maturing variety of *C. olitorius*, seed treatment, stubble clearing, proper drainage, use of protective fungicides (mainly oxides of Cu) and suitable rotation. Substitution of potato by 'kalai' (*Phaseolus mungo*) for two years gave very encouraging results.

Pests—Anomis sabulifera was wide spread during the season and insecticides were sprayed for its control. Cultivators showed interest to spray their fields by their own hands, and sprayers and dusters were temporarily issued to 100 cultivators who came within the scope of the scheme. Besides *A. sabulifera*, incidences of *D. obliqua*, *L. exigua* and *H. latus* were also noted but their incidences were negligible and control measures were taken whenever necessary. *Nupserha* was wide spread and was found in all neighbouring places of Tarakeswar including border areas within Burdwan district. It appears that the pest has firmly established itself in the area as can be seen from the table below:

TABLE XV

Acreage under Nupserha attack out of 41 acres

Year	1%–3%	4%–20%	21%–40%	above 40%
1953		Negligible		
1954	...	57.43	4.23	1.22
1955	...	56.00	1.60	0.70

During winter, survey was made in the neighbouring areas of Tarakeswar to locate the diapause stage of *Nupserha* in the field under different winter crops after jute. Diapausing larvae were found to be more in jute-kalai plots. Presence of diapausing larvae in jute-kalai plot has, however, no influence in restricting the spread of the pest, even in the initial stage, in jute-potato areas.

Folidol and Endrin were used in limited areas for pest control purposes and their performances were found to be very satisfactory.

In a trial carried out in the cultivators' field, different insecticides like Hexidol, Hexyclan, Gammexane, Lead arsenate

and DDT were used. Of these DDT gave better control of pests and yield of fibre was higher. Folidol and Endrin would be included in next years trial.

SUBSTITUTE FIBRES

Short summary of work done last year.

39 fresh collections of different fibre crops were added during the year. Two *cannabinus* and two *sabdariffa* progeny-row trials were conducted during the year. The *cannabinus* trials failed due to heavy attack of stem-rot. In the *sabdariffa* trials six cultures which gave higher yield than the control were carried forward. No significant differences were obtained amongst the four varieties in the yield trial of *H. cannabinus*. In the varietal trial of *H. sabdariffa*, R.T. 26 gave the maximum fibre yield.

36 F_2 families consisting of six combinations of pigmentations and 10 back cross families were studied and classified in *H. sabdariffa*. 85 fresh crosses and 42 back crosses were also made. Crosses made previous year to study the inheritance of earliness in mesta were grown along with their parents. 19 fresh crosses and 16 back crosses with both parents along with selection of parents were carried forward. 12 fresh crosses between palmately-lobed and partially-lobed type of leaf in *H. cannabinus* were made.

21 F_2 families of the interspecific cross between *H. radiatus* and *H. cannabinus* were grown and studied. 68 fresh crosses between different species of *Hibiscus* were also obtained during the year.

In the 'date of sowing' experiment with *H. sabdariffa* maximum plant height, base diameter and fibre yield was obtained in the sowing of first week of March. The seed-rate experiments with both *H. cannabinus* and *H. sabdariffa* were highly significant. In *H. sabdariffa*, the mortality of plants increases with the gradual increase in seed rate. A spacing of 6″ within line gave greater plant height, base diameter and

fibre yield than spacing of 2″ and 4″ within line in the spacing trial with *H. sabdariffa*. With the increase of spacing within the line the mortality of plants were found to decrease.

In the combined yield trial with different fibre crops, Roselle—both green and green-pigmented types gave significantly higher yield of fibre than all the other fibre crops included in the trial.

In a varietal trial with four sunnhemp types conducted at U.P., Kanpur-12 and S.T. 112 gave significantly higher yield of fibre over the two local U.P. strains.

Records on germination, branching habit, pigmentation of different floral parts were maintained in all the collections of Flax × Linseed strains during the period under report.

The incidence of various diseases and their epidemiology was studied. Incidence of *Agrilus acutus,* the pest on mesta and roselle was on increase. Further observations on the biology of the pest was continued. Incidence of the pest was much higher on the varieties of *Hibiscus cannabinus* than on those of *H. sabdariffa*. Not much varietal difference was obtained amongst the varieties of *H. cannabinus* and *sabdariffa*.

Breeding and Genetics

A. *Hibiscus cannabinus and Hibiscus sabdariffa*:

(*i*) *Collection of materials.*—During the period under review 25 samples of seeds of *H. cannabinus,* 34 samples of *H. sadariffa,* 1 sample each of *H. esculentus, H. tetraphyla, H. vitifolius* and *H ficulneus* and also 5 samples of unidentified *Hibiscus* species were received. All these collections were, however, from indigenous sources.

In all 33 samples of *H. cannabinus* and 56 of *H. sabdariffa* were sown. These also included 17 samples of *H. cannabinus* and 8 of *H. sabdariffa* from last year's collection which could

not be sown as they were received late in the season. The germination in all the *cannabinus* and *sabdariffa* types ranged from fair to good, excepting in the 3 collections of *cannabinus* received from West Bengal and 2 from Andhra State where the germination was poor. In one collection of *sabdariffa* from Bihar germination was nil. Records on vigour, growth and plant height, pigmentation and flowering were maintained in all these collections. 7 collections of *H. cannabinus* (1 from Nepal, 2 from Bihar and 4 from Vishakhapatnam) flowered earlier than other *cannabinus* collections. Incidence of diseases like virus and stem-rot were observed in 8 of the collections of *cannabinus,* 6 of them were indigenous and 2 foreign of last year. In *H. sabdariffa* 3 indigenous samples were also affected with chlorosis.

In other species of *Hibiscus,* germination in *Hibiscus lunarifolius* and *H. suratensis* was poor. In *H. vitifolius* the germination was nil. The collection *H. suratensis* could not be maintained as all the plants died due to a serious disease.

(*ii*) *Progeny-row tests.*—In all 4 progeny-row trials, 1 *cannabinus* and 3 *sabdariffa* were conducted during the year. The *cannabinus* trial included one first year trial ; the *sabdariffa* trials included two first year trials and one second year trial. As a result of levelling work and high heterogeneity of soil, germination and final stand were very much affected and the yield data of second year *sabdariffa* trial had to be rejected. The same trial will be repeated during next year. Records on germination, pigmentation, vigour, flowering, diseases, etc., were taken in all these trials. A total of 2400 secondary selections, 624 in *H. cannabinus* and 1776 in *H. sabdariffa,* were made. Pigmentation, height, base diameter, leaf character, date of first flowering, susceptibility to diseases and other records were maintained for individual selection.

(*a*) *Hibiscus cannabinus* : *First year trial.*—24 promising selections obtained mostly from exotic sources were tested in a

replicated randomized block trial. 624 secondary selections were made for further studies. On the basis of analysis of yield data only 6 cultures were found to be superior to control. The seeds of none of the progenies from these cultures were, however, found to be sufficient for conducting trial in the next season and as such some of these promising progenies will again be included along with the new materials during next year.

(*b*) *Hibiscus sabdariffa* : *First year tests of selections.*— In trial No. 1, 22 selections of which 11 were obtained from fresh materials and 11 from the last year's promising selections which could not be carried forward due to insufficient seeds were tested and 576 selections were made for further study. On the basis of analysis of yield data only one culture was found to be superior to control but this could not be carried forward as no progeny produced sufficient seed.

In trial No. 2, 25 selections were tested of which 14 were promising secondary selections of last year which did not produce sufficient seeds and 11 from fresh materials obtained from different indigenous sources. 624 secondary selections were made in this trial. On the basis of analysis of yield data 6 cultures have been carried forward.

Second year test of selections.—6 families brought forward from the first year trial of the previous year were tested in one trial. The trial was harvested but due to high soil heterogeneity, some abnormalities in the analysis of the data on fibre yield were obtained and it was decided to repeat the trial next year.

(*iii*) *Small scale yield trial.*—This trial was conducted with six types of *H. cannabinus* (M.T. 129, 166, 128, 102 and 150) and one indigenous (M.T. 15) in a replicated randomized block with 4 replications. Periodical records of plant height, base diameter were taken for 5 plants from each replicate. The analysis of fibre yield in this trial is, however, not significant.

(*iv*) *Varietal trial.*—A varietal trial with 3 types of *H. sabdariffa* against the control *H. sabdariffa* var. *altissima* was

conducted in replicated randomized blocks with 6 replications. The results are given below:

TABLE XVI

Varietal trial with H. sabdariffa

Layout—Replicated randomized blocks with 6 replications.
Effective plot size—1/97 acre (28′ × 16′)
Date of sowing—7-6-55.

Types	*Fibre yield per acre (md.)*	*Per cent on Control*	*Dates of Harvest*
R.T. 2 ...	16.03	148.84	9-12-55
R.T. 26 ...	15.03	139.55	28-12-55
R.T. 1 ...	11.44	106.22	28-12-55
Control ...	10.77	100.00	9-12-55
P.	0.01		
C.D.	3.087		
S.E.%	5.56		

R.T. 2 has given the maximum fibre yield but is at par with R.T. 26 and both these types have given significantly higher yield of fibre than R.T. 1 and control.

(*v*) *Interspecific hybridization*.—68 interspecific crosses of the previous year between different species of *Hibiscus* were grown. Of these only 23 F_1 families of *H. radiatus* × *H. cannabinus* and one family between *H. cannabinus* and *H. radiatus* germinated and in the rest of the families there was no germination. Germination and seed setting in F_1 were, however, very poor. 41 F_1 selections were carried forward for further study. Out of 200 backcrosses attempted 38 successful cross pods, 16 with *cannabinus* and 22 with *radiatus* were collected for further study.

21 F_2 families and 29 backcross families of *H. radiatus* × *H. cannabinus* were grown during the year. Of the 29 backcross families only 8 with *cannabinus* germinated. A total of only 9 plants from these backcross families were obtained and their phenotypic characters were recorded. Out of the 21 F_2 families grown only 27 F_2 plants were obtained and their pheno-

typic characters were also recorded 9 F_2 selections have been carried forward.

6 F_3 families were grown during the year and a total of 357 F_3 plants were obtained after germination. Only 1 F_3 plant ultimately survived at harvest and all the rest died due to heavy attack of diseases. The F_3 plant was fairly resistant to disease and has been carried forward for further study.

200 fresh interspecific crosses between *H. radiatus* and *H. cannabinus* including reciprocal crosses were attempted and only 96 successful crosses were obtained.

(*vi*) *Inheritance of character*: (*a*) *Anthocyanin pigmentation.*—53 F_2 families consisting of 6 different combination of pigmentation on plant parts and 42 backcross families of *H. sabdariffa* were studied and classified. 85 crosses of the previous years between different pigmented grades in *H. sabdariffa* were grown and F_1 characters recorded. 34 fresh crosses and 169 backcrosses were obtained.

5 crosses of last year between flowers having white stigma with normal or red stigma in *H. cannabinus* were grown during the year. Germination of F_1 families was fair and their pigmentation pattern was recorded. 14 F_1 selections have been carried forward for further study. Out of 30 backcrosses attempted only 22 were successful. 10 fresh crosses between white petal and yellow petal and 5 fresh crosses between white petal, red stigma and yellow petal, white stigma in *H. cannabinus* were obtained during the year.

(*b*) *Earliness.*—Inheritance study on earliness in *H. cannabinus* could not be continued due to heavy attack of stem-rot. 3 fresh crosses between early and late strains of *H. cannabinus* were, however, obtained during the year.

(*c*) *Leaf-shape character.*—12 crosses between palmately-lobed and partially-lobed leaf in *H. cannabinus* of last year were grown during the year. Germination was fair in all the F_1 families and the leaf shape character was recorded. 22 successful backcrosses were obtained.

II. AGRONOMY

(*i*) *Date of sowing experiment*.—This experiment was modified and conducted in replicated randomized blocks with both *Hibiscus cannabinus* and *H. sabdariffa* var. *altissima* with 8 dates of sowing commencing from the 1st April, 1955 sown at intervals of 14 days. Effects of seasonal variation on the growth, development and first flowering both the trials were noted throughout the year. In *H. cannabinus* the trial had to be harvested at bud stage due to a severe attack of stem-rot at late stage of the crop. The fibre yield data were analysed and the test is significant at 1% level. Highest fibre yield (12.88 maunds per acre) has been obtained from the sowing of last week of April. It is also noted that the fibre yield is gradually decreased as the date of sowing is delayed after the last week of April. From the observation of disease records it has been noted that earlier sowings were more attacked with stem-rot disease than the late sowings.

In *H. sabdariffa* also the trial is highly significant. The sowing of middle of April has given the highest yield of fibre (23.18 maunds per acre) though it is statistically at par with all the sowings upto middle of May. In this trial also the yield of fibre is decreased as the sowing date is delayed beyond the middle of April.

(*ii*) *Seed rate experiment with H. cannabinus*.—This experiment was repeated as in last year to determine the optimum seed rate for *H. cannabinus* with eight different seed rates ranging from 5 lb. to 40 lb. per acre. The results are tabulated below:

TABLE XVII

Seed rate experiment with H. cannabinus

Layout—Replicated randomized blocks in 5 replications.
Effective plot size—1/454 acre (12′ × 8′)
Date of sowing—3-6-55. Date of harvest—22-9-55.

Seed rate	*Fibre yield per acre (md.)*
5 lb. per acre	9.50
10 lb. ,, ,, ...	11.16
15 lb. ,, ,, ...	10.13
20 lb. ,, ,, ...	10.17
25 lb. ,, ,, ...	9.68
30 lb. ,, ,, ...	7.60
35 lb. ,, ,, ...	6.53
40 lb. ,, ,, ...	6.81
P.	0.01
C.D.	2.32
S.E.%	6.64

The trial is highly significant. Maximum fibre yield (11.16 md. per acre) is obtained with the seed rate at 10 lb. per acre, though it is statistically at par with the other seed rates ranging from 5 lb. to 25 lb. and the yield is increased from 5 lb. to 10 lb. seed rate per acre beyond which the yield of fibre gradually decreased with the corresponding increase in seed rate with slight exceptions.

(*iii*) *Seed rate experiment with H. sabdariffa*.—The experiment was repeated as in last year in *H. sabdariffa* with 8 different seed rates (5, 10, 15, 20, 25, 30, 35 and 40 lb. per acre). The trial is not significant. The general growth of plants in this trial was, however, much affected due to the general levelling work of the farm.

(*iv*) *Spacing trial with H. sabdariffa* var. *altissima*.—This trial was repeated with 15 different combinations of spacings in lines (between rows—4″, 6″, 9″, 12″ and 15″ and within rows 2″, 4″ and 6″) and broadcast sowing in replicated randomized blocks with 4 replications. The test is not significant.

As in the seed rate experiment, the growth of plants in the spacing trial was also much affected.

(*v*) *Manurial trial with H. cannabinus and H. sabdariffa.*—A non-replicated preliminary manurial trial with *H. cannabinus* to study the effects of manures (both organic and inorganic sources), lime and trace elements like zine sulphate, magnesium sulphate, sodium vanadate, ferric chloride, etc., on the incidence of diseases and pests as well as on the yield of fibre was conducted during the year. As regards the incidence of diseases and pests, no significant effect has been observed. Highest fibre yield has, however, been obtained with the treatment of 60 lb. of N per acre in the form of ammonium sulphate.

In *H. sabdariffa* a manurial trial with 5 levels of nitrogen (N_0—0 lb., N_1—20 lb. N, N_2—40 lb. N, N_3—60 lb. N and N_4—80 lb. N per acre), 2 levels of phosphate (P_0—0 lb. and P_1—25 lb. P_2O_5), 2 levels of potash (K_0—0 lb. and K_1—25 lb. of K_2O) and their Combinations 2 doses of compost (C_1—40 lb. N, and C_2—60 lb. N), and 2 doses of FYM (FYM_1—40 lb. N and F.Y.M.$_2$—60 lb. N), lime at the rate of 10 maunds per acre and a high dose of nitrogen at the rate of 100 lb. per acre was also conducted in non-replicated observational plots. The treatment nitrogen at the rate of 80 lb. per acre in the form of ammonium sulphate gave the highest yield of fibre (20.16 maunds of fibre per acre).

(*vi*) *Combined yield trial of different fibre crops.*—A combined yield trial with *Hibiscus cannabinus, H. sabdariffa Crotalaria juncea, Malachra capitata, Corchorus olitorius* and *C. capsularis* was repeated in replicated randomized blocks with 4 replications. The results are given below.

TABLE XVIII

Combined yield trial with different fibre crops

Layout—Replicated randomized blocks with 4 replications
Effective plot size—1/335 acre (13′ × 10′)
Date of sowing—3-6-55

Fibre crops		*Yield of fibre per acre (md.)*	*Date of harvest*
Crotalaria juncea (S.T. 42)	...	7.38	4-10-55
Malachra capitata (T. 78)	...	11.49	4-10-55
H. cannabinus (M.T. 128)	...	10.53	4-10-55
H. cannabinus (M.T. 130)	...	10.69	4-10-55
H. sabdariffa (R.T. 1)	...	20.03	2-12-55
H. sabdariffa (R.T. 2)	...	23.88	2-12-55
C. olitorius (C.G.)	...	20.44	19- 9-55
C. capsularis (D. 154)	...	23.50	26- 9-55
P.		0.01	
C.D.		3.42	
S.E.%		5.35	

From the table above it may be seen that the test is significant at 1 per cent level of probability. Roselle R.T. 2 has given the highest yield of fibre (23.88 maunds per acre) though it is in the same critical group with jute D 154. Sunnhemp has given the lowest yield of fibre though it is in the lower critical group with mesta M.T. 128 and M.T. 130.

(vii) Preliminary yield trial of mesta and roselle in Andhra.—Both the trials with mesta and roselle were sown very late in the season at the Sugarcane Research Station, Anakapalli. In mesta, the trial was conducted with 2 replications to study the yield and quality of fibre of 3 J.A.R.I. types against one local. The yield performances of all the types are, in general, not satisfactory. The J.A.R.I. types, however, have given higher yields than the local.

In roselle the trial was conducted with 4 J.A.R.I. types along with one local in 2 replications. The growth of the crop in general was not satisfactory and the yield was also not upto the mark. R.T. 1 has given the maximum yield of fibre (19.39 md. per acre) although there is not much difference with the rest of the types including the local.

(viii) Varietal trials of roselle in Orissa.—Two varietal trials of roselle consisting of 4 types including one local were conducted at Sambalpur and Bolangir during the year to compare the yield performances of different roselle types of J.A.R.I. against local types. The experiments were conducted in replicated randomized blocks with 5 replications. In the trial at Sambalpur, R.T. 1 has given the highest yield of fibre being 18.4 per cent over the local. The growth of the crop was, however, not at all satisfactory due to late sowing and waterlogged conditions of the land. The trial at Bolangir had to be rejected due to defective layout of the experiment.

Other Fibres—Breeding and Agronomy

The following samples of seeds and other propagative materials were collected: *Crotalaria juncea*—19 samples, *C. walkerii*—1, *C. hirsuta*—1, other *Crotalaria* species—3. *Sida cordifolia*—1, other *Sida* species—2. *Villebrunea* sp.—2. *Girardinia*—1. *Shalmalia malabaricum*—1. *Urena lobata*—2. *Kydia calycina*—1. *Abutilon indicum*—4, *A. fruticosum*—3, *A. molle*—1 and other *Abutilon* spp.—3. *Triumfetta rhomboidea*—2, *T. rotundifolia*—1. *Sesbania aculeata*—1, *S. aegyptia*—1, *S. cannabina*—1. *Helicteres isora*—6. *Thespesia lampus*—2. *Urena sinuata*—1, *Cannabis satiava*—6 ; sucker samples one each of *Agave wightii* and *A. sisalana* and 500 bulbils of another *Agave* sp ; and 1 sucker sample of *Boehmeria nivea* was obtained.

Of these only 37 collections were sown during the season and the rest could not be sown as they were received late. The germination in 3 miscellaneous collections *e.g.*, *Abutilon* sp., *Crotalaria incana* and *C. juncea* was poor. The morphological characters in all the miscellaneous collections were maintained. Five promising selections were made in all these collections and have been carried forward for further study.

(i) Sunn-hemp—Morphological characters of 11 types of Sunn-hemp were recorded. The seeds of all the types were also multiplied in winter season on a small scale.

Varietal trial Sunn-hemp in U.P.—Three sunn-hemp varietal trials were conducted at Mangari, Nizamabad and Naibazar in U.P. during 1955-56 to compare the yield and

quality of fibre of sunn-hemp types of the J.A.R.I. against the improved strain K-12 and the two local types. The trials were conducted with 4 varieties in replicated randomized blocks with 6 replications arranged in 2 blocks. Out of the above 3 trials at 3 places, only one at Mangari was successful and the remaining two had to be abandoned due to heavy floods. The results of the trial at Mangari show that the J.A.R.I. strain S.T 42 and K-12 came in the same group as regards the yield of fibre.

Other Crotalaria species.—Other species of *Crotalaria*, viz. *C. striata*, *C. incana*, *C. veracossa*, *C. anagyroides* and one unidentified *Crotalaria* species were grown in type plots and their morphological characters were noted. 5 selections in each of the species were made on the basis of earliness, height and base diameter of the plants and have been carried forward for further study.

(*ii*) *Linseed.*—Different dual purpose linseed strains were grown for observation in small plots and their records on germination, branching habit, and pigmentation of calyx, corolla, filament, anther, ovary, style and seed coat were taken.

The yield trial with 17 strains of linseed was repeated during the year with 5 replications. The statistical analysis of data on yield of fibre and seed are not yet completed.

(*iii*) *Ramie.*—Fresh ramie slips were obtained from the old plantations and they were planted in nursery. Seedlings were also raised from seeds and their morphological characters were studied.

Small scale spacing-cum-manurial trial with ramie.—This trial was conducted on observational plots in split-plot design to study the effect on the growth and development of ramie plants raised from sucker due to different spacing (3′ spacing between rows with 1′, 2′ and 3′ spacings between plants within the row) and manurial treatments (Control, nitrogen at the rate of 20 lb., 40 lb. and 80 lb. per acre in the form of ammonium sulphate). Two cuttings were taken during the period and records on average plant, height, maximum height and base diameter of

main stem, number of branches, green weight and stripped weight were taken treatment-wise at the time of harvest. Highest green weight (134.9 maunds per acre) and stripped weight (66.05 md. per acre) have been obtained with the spacing $3' \times 2'$ of the manurial treatment 80 lb. of nitrogen per acre in the second cutting. It is interesting to note that for a particular spacing both in and between the rows green weight and stripped weight have been increased in both the cuttings with the increase of doses of nitrogen.

(*iv*) *Agave sp.*—All the bulbils and suckers of *A. wightii* and *A. sisalana* collected from different areas were planted in nursery plots during the year. Spade work and manuring in the old plantation of *Agaves* were done.

III. ANATOMY AND CYTOGENETICS

Study of the Distinguishing Features of Fibre Buundles in Substitute Fibres and Characteristics of Ultimate Fibres

Length and breadth of ultimate fibres of Agave.—The study was undertaken with two species of *Agave*, *A. sisalana* and *A. cantala* received from Gobindapur Farm, Sampalpur, to standardise a method for the identification of *Agave* species from the measurements of length and breadth of ultimate fibres. Ultimate fibres from base, middle and top of 5 leaves of each of the species were studied. 100 counts of length and 25 counts of breadth of ultimate fibres were taken for each part of a leaf. The data of the two species from different portions of the leaf length are given below.

	Agave sisalana			*Agave cantala*		
	Length in mm.	*Breadth in μ*	*L/B ratio*	*Length in mm.*	*Breadth in μ*	*L/B ratio*
Base	1.921	22.97	83.70	2.038	19.74	106.69
Middle	2.449	18.85	130.14	2.477	19.56	128.74
Top	2.993	21.63	139.22	3.155	21.01	151.47
Average	2.454	21.15	117.69	2.557	20.10	128.97

From the above it is seen that the length of the fibre, in each of the species, increases from base to top of the leaf. Breadth of the fibres, on the other hand, has no such sequence

as the length. The length of the fibre at different regions (base, middle and top) of the two species is different when compared and it is always higher in case of *A. cantala*. The average length and breadth of the whole leaves of the two species are quite distinct, so also the average length/breadth ratio and are, therefore, useful for the purpose of identification. The above data also show that fibres of *A. cantala* are longer than those of *A. sisalana* and their breadth is also comparatively less. The length/breadth ratio is also higher in *A. cantala*.

Developmental studies in Sisal.—Stem tips of *Agave cantala* and *Agave sisalana* were sectioned for the study of leaf and fibre development and development of axillary buds, if any. Leaf bases of young and developing leaves were also sectioned to study the origin and development of fibres. The study of the shoot apex revealed that there is no axillary bud in the vicinity of the apical region. The development of the leaf is initiated near the apical region. The growth of the leaf is maintained by a meristematic region at the base of the leaf.

The ultimate fibres are formed in bundles of 20 or more fibres. Usually the fibre bundles are associated with vascular bundles of the leaf. They form kidney-shaped bundles over small vascular bundles and in case of bigger bundles they form two arcs above and below, covering the vascular bundle. Pure fibre bundles, very few in number, are also present near the outer region of the ground tissue of the leaf.

Fibres develop from the parenchyma cells in the vicinity of the vascular bundles. By repeated divisions of these cells a kidney-shaped (in transverse view) bundle of fibre is formed. Even in case of fibro-vascular bundles, the fibres develop from the parenchyma cells adjacent to vascular bundles and not from the cells of the phloem tissue.

Cytogenetical studies of F_1 hybrids between H. cannabinus and H. radiatus and the derivatives.—The pairing relationships of the F_1 hybrids clearly point out that some fundamental differences exist between the chromosome complexes of both the parental species. At metaphase II univalents of different size were noticed lying on the spindle and away from the equatorial plate; besides, chromosome elimination was also observed.

Out of 2010 sporads analysed, 82 per cent of them were found to be normal tetrads, about 14 per cent of the sporads, besides having four microspores, had 1 to 5 micronuclei in them, 1 to 2 being fairly common. Remaining sporads were diads and triads with or without micronuclei.

IV. DISEASES

Hibiscus cannabinus (*Mesta*)—Records of incidence of diseases in crops raised from seeds received from various indigenous and foreign sources showed that they were susceptible to a number of fungal diseases.

(*i*) *Brown rot.*—Late sown crops of the type plots excepting a few materials were universally attacked. The growing tips were lost and secondary branches developed ; as a result the plants gave a bushy appearance. A number of selections (fifth and sixth year materials) having same date of sowing showed immunity to this disease.

Early sown crops escaped infection. The disease, however, attacked all crops at harvest stage. The fungus, a species of *Volutella* seems to be a new one and does not compare well with any known species.

(*ii*) *Leaf infection and stem-rot due to Phoma sabdariffa.*—Records in the type plots showed that all types and varieties were subject to leaf infection due to this fungus. It is, however, important to note that last year a number of first year selections and materials in type plots developed stem-rot through leaf infection at seedling stage. The attack usually ended in death of the seedlings.

A perithecial stage was found in association with the pycnidial stage of *Phoma sabdariffa* on the young stems. The ascopores were mostly lenticular, hyaline to greenish, 8 in each ascus, thick walled mostly 12.0 μ × 6.2 μ

H. radiatus was also susceptible to leaf infection.

(*iii*) *Root-rot.*—A number of fungi is associated with the root-rot of mesta; of these both *Macrophomina phaseoli* (Maubl) Ashby and *Fusarium oxysporum*—alone and in combination

have been found to be pathogenic. In combination the fungi cause more damage.

Records from the 'date of sowing' experiments show that early sowings escape root-rot and may remain disease-free upto a stage when the flower bud initials are about to be laid.

Hibiscus sabdariffa var. *altissima* (*Roselle*).—Roselle was found to be less susceptible to diseases than mesta. It was found to be immune to brown-rot and stem-rot due to *Phoma sabdariffa,* although leaf infections were common. The only disease of importance was root-rot. The fungi causing root-rot are the same as mentioned in connection with *H. cannabinus.* Data obtained from a field trial showed that under Nilganj conditions potash, phosphorus or calcium added as muriate of potash, superphosphate and slaked lime respectively had little effect on the incidence of root-rot.

Crotalaria juncea (*Sunn-hemp*).—Sunn-hemp was found to be highly susceptible to root-rot disease due to *Fusarium vasinfectum* Atk. Selections proved to be 'escapes' and were found to be equally susceptible to wilt as the controls.

V. PESTS

(1) *Agrilus acutus*

(*a*) *Biology of the pest.*—Incidence of the pest is on gradual increase. Observations on biology of the pest both in the laboratory and in the field were continued. Laboratory handling of the delicate larvae still presents some difficulties. Definite evidence as to how the development of gall is induced in *H. cannabinus* by the larvae and the stage responsible for it has not yet obtained. The work is in progress.

(*b*) *Effect of different dates of sowing on the incidences of the pest.*—Observations were made on the incidences of the pest from the two dates of sowing trials conducted by the Substitute Fibre Section with *H. cannabinus* and *H. sabdariffa* as the host materials. There were altogether eight different dates of sowing. Sowings were done at interval of about a fortnight starting from the 1st April and continued till the 8th of July. In case of *H. cannabinus* crops sown during middle of April

showed much higher incidence than others. Late sown crops showed negligible per cent of attack. In case of *H. sabdariffa*, the incidence pattern with reference to different dates of sowing was more or less similar to that of *H. cannabinus*.

(*c*) *Varietal difference of H. cannabinus and H. sabdariffa on incidence.*—Monthly observations on the incidence of the pest were made from the two varietal trials (*H. cannabinus* and *H. sabdariffa*) conducted by the Substitute Fibre Section. In the mesta varietal trial there were six varieties. Of these varieties, M.T. 15 showed minimum incidence while M.T. 129, M.T. 102 and M.T. 150 showed comparatively higher incidences. In the roselle varietal trial four varieties were tried. Though incidences in these varieties were much less in comparison to the mesta varieties, no difference was observed amongst the varieties with regard to incidence.

(2) *Transmission of mesta virus*

(*i*) *Seed transmission.*—The virus is not seed transmitted. The progenies of the virus affected plants did not show up any symptoms of virus in their second generation in succession.

(*ii*) *Determination of vector species*

Study on the determination of vector species could not be done as sufficient virus affected plants were not available in the Institute's farm.

EXTENSION OF IMPROVED METHODS OF JUTE CULTIVATION

Short summary of work done last year

72 demonstration plots were sown in cultivators' fields in three centres of Barrackpore, Baraset and Basirhat. Improved methods of jute cultivation including plant protection technique were demonstrated. A preliminary enquiry into the cost of cultivation of jute under farmers' condition was undertaken at the three centres. Farmers' Week was observed at Institute in the month of September and an agricultural exhibition was organised in this connection.

The purpose of the scheme is to popularise with the growers the results of researches carried out at the Jute Agricultural Research Institute through demonstrations and to extend the area under the improved methods of jute cultivation. During the year under report the work on Extension was extended to 4 new centres in addition to the existing 3 thus bringing the total to 7 centres *viz.*, Nilganj East, Nilganj West, Baraset, Amdanga, Basirhat, Baduria and Habra—covering an area of 62 acres under 153 demonstrations plots. Another centre scheduled to be opened could not be started as the post of the Village Level Worker for the centre was not filled up. The following recommended methods were adopted:—

(*i*) Use of seeds of improved varieties.

(*ii*) Sowing in lines by seed-drill.

(*iii*) Interculture by wheel hoes.

(*iv*) Judicious application of organic manures and fertilizers.

(*v*) Adoption of plant protection measures to control diseases and pests.

(*vi*) Use of improved technique of retting and extraction of fibre.

Besides these, double and triple cropping practices were also recommended.

The demonstration plots were confined to 10 acres of land at each centre and were distributed within a radius of 5 miles from the centre. The size of the plots was about 1/3 acre each. The programme was as follows: (*a*) 3 acres of low land for double cropping with *capsularis* jute and *aman* paddy, (*b*) 4 acres of medium land—2 acres each with *capsularis* and *olitorius* jute—triple-cropped with jute, paddy and pulses, and (*c*) 3 acres of high land double-cropped with *olitorius* jute and pulses, or any other rabi crop.

The target of 70 acres fell short by 8 acres due to season being late for jute and late appointment of staff specially in Amdanga, Habra and Basirhat centres.

Sowing of 153 demonstration plots was completed under the supervision of the Extension staff covering an area of 62 acres. O these 14 plots comprising an area of about 4 acres failed due to various reasons and the remaining 139 trials were successfully conducted.

The results on the cost of cultivation show that the cost per acre is Rs. 261.81 in case of local practices and Rs. 219.90 in case of improved practices. Thus there is a saving of Rs. 41.90 *i.e.*, 16.6% of the cost of cultivation per acre over local practices by adopting improved methods. In the operations of sowing, weeding and thinning, hoeing and raking, the expenditure in the former case is Rs. 88.06 and in the latter Rs. 43.93, that is, there is reduction of about 50% expenditure by the use of seed-drill for sowing and of wheel hoe for interculture.

The average yield per acre under improved practices is 18.94 maunds of fibre as against 15.40 maunds obtained by traditional practices, *i.e.*, there is an increase of 3.54 maunds per acre or 22.92% over traditional practices. The yield of fibre obtained by improved and traditional methods in the different centres is given in table below:—

TABLE XIX

Comparative study of fibre yield under traditional and improved method of jute cultivation.

Name of centres	Yield per acre of jute in Md		Difference	% increase in yield due to improved methods
	Improved	Traditional		
Nilganj East	15.66	12.13	3.53	29.11
Nilganj West	16.90	12.33	4.57	37.06
Amdanga	15.48	13.64	1.84	13.48
Barasat	16.63	14.10	2.53	18.00
Habra	19.63	13.90	5.73	41.22
Basirhat	23.46	20.00	3.46	17.30
Baduria	24.84	21.75	3.09	14.21
Average	18.94	15.40	3.53	22.92

The cultivators of all the 7 existing centres were impressed by the effectiveness of the improved methods of jute cultivation. The actual increased demand on the part of the cultivators for improved jute seed-drill, wheel hoe, fertilizers and insecticides and fungicides shows that they were convinced of the reduced cost of cultivation and the extra profit derived from higher yield and better quality of jute fibre by practising improved methods.

In all the 7 Extension centres periodical meetings were held where demonstration of improved methods of jute cultivation and working of the implements like seed-drills and wheel hoes were given. The farmers were given chance to work with these implements and suggest any adjustments in them to suit their particular soil conditions. The demonstrations of working of plant protection applicances, retting technique, extraction and grading of jute fibre were also held.

FARMERS' WEEK AND AGRICULTURAL EXHIBITION

Farmers' Week was observed and an Agricultural Exhibition was organised in December, 1955 at the Jute Agricultural Research Institute with the object of maintaining contact with cultivators with regard to their problems of jute and paddy cultivation as well as to acquaint them with the improved methods of agriculture. Thousands of cultivators from nearby and distant villages participated in the Farmers' Week and attended the exhibition. The function was inaugurated by Dr. P. S. Deshmukh, Union Minister for Agriculture. Dr. R. Ahmed, Minister for Agriculture, West Bengal was also present. Other Ministers and high officials of the West Bengal Government also attended the function.

During the week lectures and discussions on different aspects of jute cultivation were arranged. Use of seed-drills, hand hoes and plant protection equipments was demonstrated. The exhibition which was very interesting and instructive was attended by large number of visitors including school and college students from Calcutta and other places. Films on Agriculture

and Social subjects obtained through the courtesey of the Publicity Department, West Bengal Government, United States Information Service and Messrs. Burmah Shell Ltd. were shown everyday to the cultivators.

VANAMAHOTSABA

Vanamahotsaba (Tree planting ceremony) was observed at the Jute Agricultural Research Institute on August, 1955. The function was inaugurated by Sri K. Sen, I.C.S., Secretary, West Bengal Government, Department of Agriculture. The ceremony was attended by large number of local people including cultivators to all of whom the significance of tree planting for the welfare of the country was explained.

TRAINING

Refreshers' Course in improved methods of jute cultivation and improved retting technique for the production of quality jute, of three sessions of 21 days each during September and October, 1955 were arranged at the Jute Agricultural Research Institute for the Jute Development staff of Assam, Bihar and Orissa Governments. Each session of the course were attended by 13, 10 and 15 members of the staff from the above States respectively.

PRODUCTION OF SEEDS OF IMPROVED AND OTHER VARIETIES AT THE JUTE AGRICULTURAL RESEARCH INSTITUTE FARM

A total quantity of about 40 maunds of *capsularis* and *olitorius* seeds were produced. Due to shortage of cultivable land in the farm it was not possible to multiply more seeds.

Only about 9.12 acres were under seed crop. The names of the varieties and the quantities of seeds produced are shown below:

Area and total production of seeds
1955-56

Variety	*Area*	*Seed obtained*		
		Md.	Sr.	Ch.
JRC-212 ...	2.42	17	19	8
JRC-321 ...	0.50	1	32	0
JRC-412 ...	0.25	1	11	0
Fanduk ...	0.12	0	13	0
D 154 ...	0.40	3	6	0
JRC-5854 ...	0.25	0	30	8
JRC-919 ...	0.16	0	30	8
JRC-918 ...	0.25	0	9	12
JRC-1 ...	0.12	0	8	0
Total *Capsularis* ...	4.47	25	39	4
Olitorius				
JRO-632 ...	3.25	10	23	0
JRO-753 ...	0.50	1	2	0
JRO-620 ...	0.25	0	28	0
C.G. ...	0.50	1	22	0
R-26 ...	0.05	0	3	12
JRO-52-7460 ...	0.10	0	5	0
Total *Olitorius* ...	4.65	14	3	12

After meeting the requirement of the Institute for experimental purposes and keeping requisite quantities for the nucleus Jute Seed Multiplication Farm, some quantities were distributed to the different jute growing States.

LIBRARY

During the year under report 114 books and good number of government and non-government reports and pamphlets on agriculture and allied subjects have been added to the library stock thus raising the total collection to 4132. 116 scientific periodicals have been received of which 81 are on payment of subscription, 17 on exchange basis and the rest are complimentary. 120 volumes of periodicals have been bound during the year.

As before the library continued to be used frequently by members of the staff of the Institute and also research workers of different scientific institutions. During the period under report 1156 publications have been issued on loan from the library.

Attempt is being made to develop the library of the Institute into an up-to-date agricultural library by procuring almost all important and latest publications. Rare publications are also purchased whenever possible.

MISCELLANEOUS

Enquiries.—During the year under report a number of enquiries relating to jute and substitute fibre crops were received for comments from the Government of India and various Indian and Foreign sources including industries and research Institutes. Suitable notes in reply were prepared and communicated.

Changes in the staff. -The following appointments were made during the period.

Sri M. N. Sandilya, Agronomical Assistant	...	12-5-55
Sri S.S. Jana, Jr. Mycological Assistant	...	19-5-55
Sri S. K. Majumder, Agronomical Assistant, Development Block	...	20-5-55
Sri Subrata Sen, Agronomist	...	1-7-55
Sri B. K. De Sarkar, Physiological Assistant	...	20-7-55
Sri S. C. Rakshit, Herbarium Assistant	...	22-8-55
Sri S. Ghosh, Jr. Chemical Assistant ...	...	1-9-55
Sri A. B. Roy, Jr. Chemical Assistant ...	...	20-9-55
Sri J R. Saha, Jr. Physiological Assistant	...	1-10-55
Sri K. Ghosh, Technical Assistant ...	...	1-11-55
Sri M. S. Sarma, Senior Botanical Assistant	...	1-11-55
Sri S. C. Chakravorty, Sr. Chemical Assistant	...	1-11-55
Sri N. Mukherjee, Sr. Mycological Assistant	...	15-11-55
Sri D. K. Dutta, Sr. Entomological Assistant	...	16-12-56
Sri S. Pal Choudhury, Sr. Agronomical Assistant	...	8-2-56
Sri M. L. Nandy, Assistant Librarian	...	5-3-56

The following members of the staff have resigned after getting better appointments elsewhere.

Sri R. M. Dutta, Cytological Assistant	...	1-8-55
Sri S. S. Jana, Jr. Mycological Assistant	...	25-9-55
Sri R. N. Ganguly, Entomological Assistant	...	25-3-56

Visitors.—A number of distinguished personalities visited the Institute during the period under report and showed keen interest in the progress and achievements of the Institute. The names of the following may be mentioned.

Dr. P. S. Deshmukh, Union Minister for Agriculture, Government of India.

Dr. R. Ahmed, Minister for Agriculture and Animal Hunbandry, West Bengal.

Dr. J. R. Dhar, Minister for Prisons and Jails, West Bengal.

Shri M. V. Krishnappa, Union Deputy Minister for Food and Agriculture, Government of India.

Shri Abdus Shokur, Deputy Minister for Agriculture, West Bengal.

Shri P. N. Thapar, I.C.S., *Secretary,* Ministry of Food and Agriculture, Government of India.

Shri K. R. Damle, I.C.S., *Additional Secretary,* Ministry of Food and Agriculture, Government of India. *Vice-President,* Indian Council of Agricultural Research and *President,* Indian Central Jute Committee.

Shri M. S. Randhawa, I.C.S., Additional Secretary, Ministry of Food and Agriculture, Government of India, *Vice-President,* Indian Council of Agricultural Research and *President,* Indian Central Jute Committee.

Shri K. Sen, I.C.S., *Secretary*, Government of West Bengal, Agriculture and other Departments.

Dr. A. H. Moseman, Director of Crops Research, U.S. Department of Agriculture, Washington

Dr. E. E. Leasure, Dean, School of Veterinary Medicine, Kansas State College , U.S.A.

Dr. Robert E. Buchanon, Director and Dean Emeritus, Iowa State College, U.S.A.

Dr. H. K. Nandi, Director of Agriculture, West Bengal.

Members of the Indo-American Team on Agricultural Research and Education.

Dr. Richard Bradfield, Rockefeller Foundation, New York.

Dr. F. W. Parker, T.C.M., New Delhi.

Dr. J. H. Longwell, Columbia, Missuri, U.S.A.

Dr. William W. Harrison, Columbia, Missori, U.S.A.

Prof. Lin Chunglo, Academia Sinica, Peking, China.

Prof. L. I. Scott, University of Leeds, England.

Dr. H. W. Hannah, Assoc. Dean, College of Agriculture, University of Illinois.

Dr. E. F. Daniel, Production Economist (Agri.), University of Kentucky.

Mr. M. Gopala Menon, Consul General Designate, New York.

Sri B. R. Gupta, I.A.S., District Magistrate, 24-Parganas.

Dr. R. J. Kalamkar, Additional Agricultural Commissioner, I.C.A.R., New Delhi.

Pandit Dr. Gouri Nath Shastri.

Mr. G. C. Dash, I.A.S., Director of Agriculture, Orissa.

Dr. J. K. Daji, Assistant, Agricultural Commissioner, I.C.A.R., New Delhi.

Shri M. Banerjee, Assistant Director, Commercial Intelligence, Government of India.

Dr. P. Sen, School of Tropical Medicine, Calcutta.

Shri J. K. Damodaran
Shri Ashoke Senchib
Shri N. P. Jain
Shri N. P. Alexander
Shri Manjit Singh
Shri S. S. Nair

Ministry of External Affairs, Government of India.

ACKNOWLEDGEMENT

I take this opportunity of expressing my sincere thanks to the members of the staff of the Jute Agricultural Research Institute for the ungrudging help and co-operation rendered by them in the successful implementation of the various types of work carried out in this Institute during the period under report.

B. C. KUNDU,
Director,
Jute Agricultural Research Institute.

PUBLICATIONS

The following is a list of papers published or sent for publication during the year :—

1. Das, B. K. and Dua, D. B.—Response of jute to nitrogen from different inorganic sources, Jute Bulletin, August, 1955.

2. Das Gupta, B. and Ghosh, K.—Genetics of *corchorus* (Jute) VIII. Inheritance of non-rugate capsule character in *C. capsularis* Linn. Ind. Jour. Agri. Sci. (In press).

3. Dutta, A. K. and Kundu, B. C.—Characteristics of fibre bundles in different species of *Agave*. Proc. Ind. Sc. Cong. III, 1956.

4. Datta, A. N. and Sanyal, P.—Preliminary studies on the seed-rate of *Hibiscus cannabinus* L. Proc. Ind. Sc. Cong. III, 1956.

5. Datta, A. N., Sanyal, P and Kundu, B. B.—Effect of different spacings in row-cropping of *Hibiscus sabdariffa* var. *altissima,* Jute Bulletin, October, 1955.

6. Datta, R. M. and Patel, G. I.—Interspecific hybridization in the genus *Corchorus*. Proc. Ind. Sc. Cong. III, 1956.

7. Dutt, N.—Studies on *Nupserha bicolor* Thoms ssp. *post brunnea* Breun (Col., Lamiidae) IV. Preliminary observations on the immature stages and elimination of larval diapause, Jute Bulletin, 18. No. 10, 1956.

8. Dutt, N. & Ganguli, R. N.—Studies on *Pseudococcus filamentosus* Skll var. *corymbatus* Gr. with reference to its damage to jute crop. Proc. Ind. Sc. Cong. III, 1956.

9. Dutt, N. and Ganguli, R. N.—Time of exposure and mortality relation between D. D. T. and *Anomis*

sabulifera Guen (jute semi-looper). Proc. Ind. Sc. Cong. III, 1956.

10. Dutt, N. & Ganguli, R. N.—Comparative effectiveness of some insecticides for control of *Anomis subulifera* Guen (Jute semi-looper). Proc. Ind. Sc. Cong. III, 1956.

11. Ghosh, T.—Anthracnose of jute. Proc. Ind. Sc. Cong. III, 1956.

12. Giri, N. C.—Use of technical heights of jute plants for the study of manurial effects on fibre yields. Proc. Ind. Sc. Cong. III, 1956.

13. Gurnani, K. L.—Methods of Agricultural Extension. Jute Bulletin. (In press).

14. Kar, B. K.—Determining factors in the production of quality jute. Textile India, 1955.

15. Kar, B. K. & De Sarkar, B. K.—Physiological studies on the growth of *Hibiscus cannabinus* and *Hibiscus sabdariffa* var. *altissima* with reference to the formation of certain growth components. Proc. Ind. Sc. Cong. III, 1956.

16. Kar, B. K. & De Sarkar, B. K.—Root system in two species of jute. Proc. Ind. Sc. Cong. III, 1956.

17. Kundu, A. K. and Halder, G.—A short note on the effect of pH on retting period of jute. Proc. Ind. Sc. Cong. 1956.

18. Kundu, B. C.—Possibilities of growing some bast fibre plants in higher altitudes and colder climate. Presented in symposiun of National Institute of Sciences, 1955.

19. Kundu, B. C.—Sisal cultivation. Jute & Gunny Review, 1955.

20. Kundu, B. C.—Progress of Research on Jute Supplement of Statesman. August, 1955.

21. Kundu, B. C.—Indian Jute. Bagology, 1955.

22. Kundu, B. C.—Ramie fibre. Textile India, 1955.

23. Kundu, B. C., Das, B. K. and Dua, D. B.—Possibilities of double and triple cropping of aman paddy lands with jute as the first crop. Science & Culture. (In press).

24. Kundu, B. C., Mukherjee, M. K., Rao, N. S. and Chakravorty, S. C.—Role of phosphates on the yield and quality of jute. Proc. Ind. Sc. Cong. III. 1956.

25. Kundu, B. C., Rao, N. S. and Saha, S. B.—Origin and development of axillary buds in three species of *Corchorus*. Bull. Bot. Soc. Beng. Vol. 8 pp. 216-220. 1955.

26. Mukherjee, M. K., Chakravorty, S. C. and Ghosh, S. —Phosphate manuring in jute. Proc. National Academy of Science. (In press).

27. Mukherjee, M. K. and Ghosh, S.—Use of ammonium chloride as a fertilizer for jute. J. Indian Soc. Soil Sci. IV. 55. 1956.

28. Mukherjee, M. K., Kundu, A. K. and Halder, G.—A note on the utilization of retting water as fertilizer. Proc. Ind. Sc. Cong. III. 1956.

29. Patel, G. I. and Datta, R. M.—Cytology of $2N \times 4N$ population of jute (Corchorus olitorius Linn. Var. C.G.). Proc. Ind. Sc. Cong. III. 1956.

30. Sanyal, P., Datta, A. N. and Kundu, B. C.—Seed-rate of *Hibiscus sabdariffa* L. Ind. Jour. of Agr. Sc. (In press).

31. Sanyal, P. and Patel, G. I.—Interspecific hybridization in *Hibiscus* and the meiotic behaviour of F_1 hybrids. Proc. Ind. Sc. Cong. III. 1956.

32. Sen, S. N.—Study of topographic models by the auto-regression schemes. Proc. Ind. Sc. Cong. III. 1956.

33. Sen, S. N. and Giri, N.—Study on the estimation of fibre yield. Proc. Ind. Sc. Cong. III. 1956.

34. Sen, S. N., Giri, N. and Kundu, B. C.—Preliminary study of expenditure pattern of the families of the jute cultivators. Proc. Ind. Sc. Cong. III. 1956.

STAFF (1955-56)

1.	Director ...	...	Dr. B. C. Kundu, M.A., Ph.D. (Leeds), F.L.S., F.N.I.
2.	Technical Assistant to Director ...	...	Sri K. Ghosh, B.Sc., B.Ag.

Agronomical Section

1.	Agronomist	...	Sri S. Sen, M.Sc., Assoc. I.A.R.I.
2.	Assistant Agronomist	...	Sri B. K. Das, B.Sc. (Ag.).
3.	Senior Assistant	...	Sri S. Pal Chowdhury, B.Sc., B.Ag.
4.	Assistant ...	...	Sri D. B. Dua, B.Sc. (Ag.).
5.	—do— ...	...	Sri M. N. Sandilya, B.Sc. (Ag.).

Botanical Section

1.	Botanist ...	...	Sri B. Das Gupta, M.Sc.
2.	Assistant Botanist	...	Sri B. Roy, M.Sc.(Cal.), M.Sc. (Lond.).
3.	Senior Assistant	...	Sri M. S. Sarma, M.Sc.
4.	Assistant ...	...	Vacant.
5.	—do— ...	...	Vacant.
6.	Herbarium Assistant	...	Sri S. Rakshit, M.Sc.

Cytogenetical Section

1.	Cytogeneticist	...	Dr. G. I. Patel, B.Sc.(Ag.), M.S., Ph.D.(California).
2.	Assistant ...	...	Vacant.

Anatomical Section

1.	Senior Anatomical Asstt.		Vacant.
2.	Anatomical Assistant (In charge) ...		Sri N. S. Rao, M.Sc.(Ag.).
3.	Assistant ...	...	Dr. A. K. Datta, M.Sc., D.Phil. (Cal.).
4.	Junior Assistant	...	Sri S. B. Saha, B.Sc.

Physiological Section

1.	Physiologist	...	Dr. B. K. Kar, M.Sc., Ph.D. (Leipzig).
2.	Assistant ...	...	Sri B. K. De Sarkar, B.Sc.
3.	Junior Assistant	...	Sri J. R. Saha, B.Sc.

Chemistry Section

1.	Chemist ...	...	Dr. M. K. Mukherjee, M.Sc., Ph.D.(Dacca).
2.	Assistant Chemist	...	Vacant.
3.	Asst. Microbiologist	...	—do—
4.	Senior Assistant	...	Sri S. C. Chakravorty, M.Sc.
5.	Microbiological Asstt.	...	Sri A. K. Kundu, M.Sc.
6.	Chemical Assistant	...	Vacant.
7.	Biochemical Asstt.	...	Sri G. Halder, B.Sc.
8.	Jr. Chemical Asstt.	...	Sri S. Ghosh, B.Sc.
9.	—do—	...	Sri A. B. Roy, B.Sc.

Mycological Section

1.	Assistant Mycologist	...	Sri T. Ghosh, M.Sc.
2.	Senior Assistant	...	Sri N. Mukherjee, M.Sc.
3.	Assistant ...	...	Sri M. Basak, B.Sc.
4.	Junior Assistant	...	Vacant.

Entomological Section

1.	Asstt. Entomologist	...	Sri N. Dutt, M.Sc.
2.	Senior Assistant	...	Sri D. K. Dutt, M.Sc.
3.	Assistant ...	...	Vacant.
4.	Junior Assistant	...	Sri S. P. Bhattacharjee, B.Sc.

Substitute Fibre Section

1.	Assistant Botanist	...	Vacant.
2.	Assistant ...	...	Sri P. Sanyal, M.Sc., Assoc. I.A.R.I. (Remained in charge of the Section during the period under report).
3.	—do— ...	...	Sri A. N. Dutta, B.Ag.

Extension Section

1.	Extension Agronomist	...	Sri K. L. Gurnani, B.Ag., M.S. (Texas), Assoc. I.A.R.I.
2.	Assistant ...	...	Sri S. K. Majumdar, B.Sc. (Ag.).
3.	—do— ...	...	Vacant.
4.	—do— ...	...	Vacant.

Statistical Section

1.	Statistician ...	...	Sri S. N. Sen, M.Sc.
2.	Assistant ...	...	Sri N. C. Giri, M.Sc.

Library

1.	Librarian ...	...	Sri A. K. Sur, M.Sc., Dip.Lib.
2.	Asstt. Librarian	...	Sri M. K. Nandi.

Farm

1.	Farm Manager	...	Sri P. K. Das, B.Sc., B.Ag.

Office

1.	Head Clerk	...	Sri R. Chakravorty, B.A.

APPENDIX

APPENDIX

Programme of work as sanctioned	Progress of work in 1955-56	Future programme of work in 1956-57
I. Breeding and Genetics of jute		
1. Collection of varieties and types including wild species of *Corchorus*.	129 indigenous and 3 exotic samples of seeds were grown and studied. In all 206 primary selections including 6 selections from local cultivators' plots were made.	To be continued.
2. Breeding of improved strains of jute.	17 progeny-row trials, 10 *capsularis* and 7 *olitorius*, with selections from cultivators' types and X-irradiated materials were conducted and 6804 secondary selections were made. Two *capsularis* varietal trials, one with early and the other with late varieties were conducted. In trial No. 1 the early varieties JRC-322 and JRC-321 yielded about 31 and 11 per cent higher respectively than the early control Fanduk, though they were statistically in the same group. JRC-322 and JRC-321 maintained their high quality ratio. In trial No. 2 the late varieties JRC-919 and JRC-212 yielded about 14 and 3 per cent higher respec-	To be continued.

	tively than the control D154. JRC-212 maintained its high quality ratio. *Varietal trial in State farm.*—A *capsularis* varietal trial was conducted with six varieties viz. JRC-321, JRC-412, JRC-212, Fanduk, D154 and 'local' under low land conditions in the Gograghat Farm, U.P. The early variety JRC-412 gave the highest yield and proved significantly superior to Fanduk and JRC-212. It yielded about 8 per cent and 10 per cent higher than the 'Local' (control) and D154 respectively.	
Subvention trials in cultivators' plots.	Of the 102 trials planned 82 were sown. Final reports on 8 trials in Bihar are awaited. Of the remaining 74 trials 32 (26 *capsularis* and 6 *olitorius*) were finally reported to be successful. The remaining 41 trials failed due to various reasons. The yield data of the successful *capsularis* subvention trials carried out during the three years from 1952-53 to 1954-55 in West Bengal, Bihar, Assam, and U.P. were analysed and overall performances of the *capsularis* strains were estimated. In West Bengal JRC-13, D154 and JRC-212 yielded about 9, 9 and 8 per cent higher respectively than the control	To be continued.

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	'locals' though they were statistically in the same group. In Bihar JRC-1, JRC-212 and D154 proved significantly superior to the 'locals' at 1% level yielding about 15, 14 and 13 per cent higher respectively. In Assam JRC-321, D154 and JRC-1 proved significantly superior to the 'locals' at 1% level yielding about 17, 13 and 12 per cent higher respectively. In U.P. JRC-212 and JRC-1 proved significantly superior to the 'locals' at 1% level yielding about 24 and 23 per cent higher respectively. Serial analysis of the three years' data from Orissa is yet to be done ; the mean yield per acre of JRC-13, JRC-212 and D154 were 21.3, 21.2 and 20.9 mds. respectively as against 19.2 mds. of the 'locals'. The yield data of the *olitorius* subvention trials in the five States during 1952-53 to 1954-55 show that in West Bengal JRO-632, JRO-753 and JRO-620 gave mean yields of about 22.24, 21.29 and 20.18 mds. per acre respectively as against 18.5 and 17.7 mds. per acre of	

	C. G. and 'locals'. In Assam the performances of the improved strains followed the same trend as in West Bengal. The results of the *olitorius* subvention trials carried out in Bihar, Orissa and U.P. were inconclusive, the data being inadequate.	
Polyploidy.	The progenies of the *capsularis* polyploids of 1950 colchicine treated series maintained the characteristics of polyploids. Almost all the selections of the normal *olitorius* tetraploids gave one or two narrow-leaf variants. The progenies of the narrow-leaf variant selected last year segregated into normal and variant.	To be continued.
Studies on irradiation with X-rays.	X_4 generations--Out of 28 *capsularis* selections grown, 4 gave only normal plants, 13 segregated into plants having irregularly serrated wavy leaves and plants with normal leaves and 11 segregated into sterile, short-leaf variant and normal plants. Only one plant was obained from the seeds of the *olitorius* dwarf and late variant but it died at the seedling stage. Progenies of the normal-looking *olitorius* plants segregated into dwarf—late variant and normal-looking plants. F_1 progenies of the crosses between the *olitorius* dwarf—late variant and the normal were all normal.	To be continued.

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	X_3 generation—Out of the five normal and branching *capsularis* selections grown, only one segregated into branching and non-branching plants and the rest gave normal progenies. Progenies of three other *capsularis* selections segregated into plants with normal and small pods. Of the two *olitorius* selections one gave progenies which were late in maturity and the other segregated into early and late types. Variations in respect of leaf and pigmentation hitherto unobserved were also recorded in X_3 and X_4 generation.	
Vegetative rapprochement as a means of overcoming interspecific cross incompatibility in jute.	Seeds from both stocks and scions of the fith generation grafts were sown. A few sixth generation grafts were made but due to adverse weather conditions no seeds were obtained from both stock and scion of the grafts.	Discontinued.
II. Genetics of Jute Genetic strains.	102 selections from true breeding cultures were grown. 561 selections were made in these cultures. 70 selections were grown in	To be continued.

	the purification series and eight cultures were found to be true breeding. 198 selections were made.	
Isolation of full-green genotypes.	70 test crosses along with 27 parents were grown. 13 parents belonging to the six full-green genotypes were confirmed. 27 fresh crosses were obtained for confirmation of the known genotypes and isolation of the remaining genotypes.	To be continued.
Leaf variants.	*Capsularis — Deeply-serrated, female-sterile type.*—25 selections of the normal phenotype were grown. The number of families segregating and that of the normal and the variant segregates in them were recorded ; the data are under study.	Completed.
	Crumpled-leaf type (i) *Capsularis.*—The F_2 and the back-cross families segregated into 3 normal : 1 crumpled and 1 normal : 1 crumpled ratios respectively showing that the inheritance of the crumpled-leaf character is monogenic ; the normal leaf being dominant over the crumpled.	To be continued.
	(ii) *Olitorius.*—The F_1 progenies of the crosses between the crumpled-leaf *olitorius* and the normal were all normal. Back-crosses were made for further studies.	To be continued.

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Plant height.	Seeds of seven F_1s, six F_2s and 23 back-crosses were sown. Germination was very poor and all the materials had to be rejected.	Discontinued.
Earliness in *C. capsularis*.	Several back-crosses, fresh crosses and selections of F_1 and F_2 progenies of inter-varietal crosses covering various combinations of early, medium and late types, brought forward from the previous year, were grown. The variations in respect of maturity in the different cultures were noted.	To be continued.
Inheritance of blotched leaf in *C. olitorius*.	F_1 progenies of the crosses between the blotched leaf and the non-blotched leaf were all blotched. Back-crosses were made for further studies.	To be continued.
Chlorosis.	Four *capsularis* and two *olitorius* chlorotic cultures bred true to their parents. Back-crosses with the non-chlorotic parent and the F_2 families segregated into chlorotic and non-chlorotic progenies during the early stage but with the onset of the reproductive phase almost all the progenies became chlorotic. The progenies of the back-crosses with the chlorotic	

	parent were, however, all chlorotic. Among the F_3 families, the progenies of all of the chlorotic selections were all chlorotic and those of the rest behaved as in F_2 families.	
III. Cytogenetics		
Interspecific hybridization.	Several crosses between the cultivated as well as between the wild types of *olitorius* and *capsularis* were done at their diploid and polyploid level. Few full seeds obtained in certain crosses failed to germinate.	To be continued
Incompatibility studies.	In the pistils collected after $1\frac{1}{2}$ hours of cross-pollination (C. G. ♀ × D154 ♂), several grains were found sending out tubes in the styles.	To be continued
Cytological studies.	A great variation in chromosome pairing is observed in the autotetraploids of *C. olitorius* (C. G.). Six types of quadrivalent configurations were noticed—ring and chain shaped ones being the most common. The distribution of chromosomes in both the divisions is highly irregular. Spoard analysis, pollen germination and pollen grain studies were done.	To be continued.

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X-irradiation in jute.	X-irradiation treatments could not be undertaken for want of X-ray equipment.	To be continued.
IV. Anatomy		
Structure and quality of fibre.	The length, breadth and lumen size were measured in JRC-212, Fanduk, JRC-1, D154 and JRC-918. Work is still in progress.	To be continued.
The effect of fertilizers on the formation and development of fibre.	The number of ultimate fibres in a cross-section of fibre strand, length and breadth of the ultimate fibres thickness of the wall and wood-bast ratio were recorded to find out the variation with the application of ammonium sulphate, compost and superphosphate.	The entire work will be repeated for confirmation of the results.
Routine identification.	Fibre samples received from various sources were examined microscopically and necessary informations were supplied.	To be continued.
V. Physiology		
1. Investigation on the physiology of jute seeds. (i) Viability efficiency of seeds collected at different stages of maturity.	Seeds from *capsularis* varieties (D154, Fanduk and JRC-212) collected at half matured capsules stage showed higher percentage	To be continued.

	of germination than seeds from *olitorius* varieties (C. G., JRO-632 and JRO-753) of the same half matured capsule stage. The above results were correlated with different stages of harvest for dual purpose of growing jute.	
(ii) Investigations on dual purpose of harvesting.	Further details were obtained from field trial continued with *capsularis* (D154, Fanduk, JRC-212) and *olitorius* (C. G., JRO-632 and JRO-753) on the time of harvest in these varieties when they can be grown profitably for fibre as well as seeds. Tentative results on the maturity of capsule and fibre have been obtained for each variety. The results can be utilised for dual purpose of harvesting seed as well as fibre.	To be continued in a modified form, if possible in Seed Multiplication Farm.
2. Nature and range of flowering and seed formation in different varieties of jute.	Continued progress was made on this aspect work. Detailed results on D154, Fanduk, Jap Red, JRC-212, JRC-13, JRC-321 (*capsularis*) and C. G., R-26, JRO-620, JRO-632 and JRO-753 (*olitorius*) were obtained. The results have been studied, from the following aspects, —correlation of vegetative and reproductive phases, rate of fibre production during the two phases, inheritance of lateness or earliness in flowering and performance of seeds formed at different points or weeks of flowering range.	To be continued.

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3. Effect of vernalization and photoperiods on the phasic development of jute plants.	The short day treatment was given by curtailing light in the morning in one set and by curtailing the light in the evening in another set. The above treatment was repeated at different ages of the plant. The results have been discussed with reference to the degree of earliness.	To be continued with very late varieties.
4. Experiments on salt tolerance.	Field trials in the saline area of Kakdwip in Sundarban area was carried out with D154, Fanduk, JRC-212, JRC-321, JRC-13 (*capsularis*), C.G., R26, JRO-620, JRO-632 and JRO-753 (*olitorius*). The salt concentration in the soil at the time of sowing was 1.0% to 2.0% of Nacl. *Olitorius* varieties did not grow well. But *capsularis* varieties were found to be more salt-tolerant. JRC-212 showed the best performance. Attempts were made to induce tolerance by pre-sowing seed treatment with difference concentrations of Nacl with cultivated and wild species.	To be continued if the special scheme is extended.
5. Investigations on the variations of growth components during the life-cycle of the plant.	The results obtained during the previous years were further followed up with a view to find out the relation of fibre growth with other	To be continued.

	growth components. The fibre percentage, thus estimated in individual varieties was utilised to assess the fibre producing potentiality of the varieties as most important criterion for selection. Field data by stripped bark method, have been collected on many plants together with basal diameter and height in order to find out the fibre percentage in the living plants. Correlation studies have also been made in many varieties.	
6. Growth sequence in relation to stalk and foliage.	The rate of growth in nitrogen series in presence of phosphorus was more marked than in absence of phosphorus. The proportion of stalk growth and foliage growth in terms of green weight showed proportional increase in nitrogen series. Presence of potassium increased foliage growth.	To be continued.
7. Experiments with different nutritional levels.		
(i) Effect of different manures and their combinations on the growth of jute under field conditions.	The results indicated that nitrogen, phosphorus and potassium influenced the growth as compared to no-manures. The influence of nitrogen as N_1 (20 lb. N) and N_2 (40 lb. N) alone was the most prominent than either phosphorus or potassium. Performance of nitrogen was markedly influenced in combination with	To be continued.

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	phosphorus than with potassium. D154 recorded more increased growth in nitrogen levels than JRO-632.	
(ii) Cultural experiments in tubs with N,P,K.	Conducted under controlled pot culture experiments, with different conc. of 0.125%, 0.250% and 0.375% of N,P,K in terms of the total dry soil of pots. The effect of nitrogen was clearly seen, but the role of potassium was not much noticed. Nitrogen in combination with phosphorus gave better growth than nitrogen alone.	To be continued.
(iii) Sand culture experiments in presence or absence of certain trace elements as Mn, Zn and Bo.	The results showed that in absence of Zn and Mn. the plants were found deficient in chlorophyll and general growth was affected. Boron deficient cultures were of stunted growth and tips affected.	To be continued.
VI. Agronomy		
1. (a) Variety-cum-manurial trial.	In *olitorius* the effects due to different doses of fertilisers and varieties were both significant, but that due to interaction was insignificant. Application of 20 lb. N proved as good as 40	To be continued.

	lb. N or 60 lb. N. Among the varieties JRO-632 gave the highest yield of fibre. In *capsularis* trial no significant responses were obtained.	
(b) Growing jute in lines.	In *capsularis* fibre yields in line plots were significantly superior to broadcast plots. The treatment 3″ × 12″ rendered about 26 per cent increase in the yield of fibre over control (broadcast). In the case of *olitorius* the treatments 1″ × 12″ and 3″ × 12″ gave significantly higher yields over control and the percentage increase in the yield of fibre was 16 to 17 over control.	To be continued.
	Seed rate was reduced by about 50 per cent in line sowings as compared to broadcast. The cost of production was also considerably reduced in line plots in both *capsularis* and *olitorius* jute.	Effect of various spacings on yield of jute seed and fibre.
2. Manurial trials.		
(a) Effect of N, P & K on *capsularis* and *olitorius* jute.	Effect of nitrogen was significant in the case of *capsularis*. Responses due to application of P or K or PK were found to be insignificant. The treatment 40 lb. N alone gave the highest yield of fibre (22.84 md. per acre). Responses to higher doses of N were not so	To be continued.

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	marked in case of *olitorius* jute. Application of 20 lb. N gave almost same result as that of 40 lb. N.	
(b) Comparative merits of various nitrogenous fertilisers on *capsularis* and *olitorius* jute.	The effect of fertilisers was significant at 1 per cent level. All the fertilisers, (except urea, Paul's mixture and Talukdar's mixture) as a source of nitrogen proved superior to control and on an average the percentage increase in the yield of fibre was 6 to 14 over control. The varietal effects and the effects due to interaction (fertiliser and variety) were not significant.	To be continued.
(c) Comparative merits of organic manures against ammonium sulphate on *capsularis* and *olitorius* jute.	The *olitorius* trial has to be rejected partly due to adverse weather conditions and partly due to serious attack of white ant. In case of *capsularis* the treatment differences were not very prominent.	To be continued.
(d) Effect of time of application of fertilisers in instalments.	The trials could not be conducted for want of land.	To be continued in modified form.

(e) Effect of organic and inorganic nitrogen in various proportions on yield of jute.	Could not be conducted for want of land.	To be continued.
3. Manurial trial in States.	Simple manurial trials were conducted in both acid and non-acid zones in the cultivators' plots in various jute growing states. In Bihar the highest yields were obtained from application of 30 lb. N plus 40 lb. K_2O plus 30 lb. P_2O_5 in non- acid zone and 6 maunds of lime plus 20 lb. N in acid zone. In West Bengal substantial increases in the yield of fibre was recorded from application of 20 lb. N alone, but the highest yield was obtained from application of 30 lb. N in combination with 40 lb. K_2O and 30 lb. P_2O_5. In Assam, application of 30 lb. N together with 30 lb. P_2O_5 or 40 lb. K_2O enhanced the yield of fibre considerably giving an extra yield of 4 to 6 maunds of fibre per acre. In Orissa the effects of fertilisers were not very marked. In U.P. only a few trials were successful. Higher dose of N together with P or K or both proved beneficial to jute.	To be continued.

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4. Date of sowing with *capsularis* and *olitorius* jute.	In both *capsularis* and *olitorius* the effects due to date of sowing and varieties were significant at 1% level. Sowing done from the beginning of April upto middle of May gave the highest yields of fibre. Late varieties proved significantly superior to early varieties.	To be continued in modified form.
5. Effect of stage of harvest on jute.	It was tried on a small area but unfortunately due to unfavourable weather conditions, the results obtained were not upto the mark.	To be taken up on a bigger area and in a modified form.
6. Triple cropping experiment on jute, paddy and pulses.	Could not be conducted for want of land.	To be continued. Varietal trial on paddy to find out the suitable variety for the locality. Time of transplanting of paddy to determine the optimum time. Intercultural trials, seed rate on yield of jute seed and fibre.
Green Manuring		
1. Maintenance & observation of species and varieties of green manuring plants.	Plants raised from 35 different types were studied in type plots.	To be continued.

2. Observations on yield of types found promising from (1) and study with regard to their incorporation on yield of paddy.	*Vigna catjang*, *Sesbania aculeata*, *Phaseolus mungo*, *Crotalaria juncea* *Phaseolus trilobus* were studied. 3 period of decomposition—30 days, 20 days and 10 days—were given. Green manuring crops decomposed within 10 to 20 days gave good results, on the yield of paddy.	To be continued.
3. Preliminary studies on the possibilities of growing various green manuring crops in relation to its time of sowing between standing jute rows of different widths and jute age.	*Sesbania aculeata*, *Crotalaria juncea*, *Vigna catjang*, *Phaseolus mungo* and *Phaseolus trilobus* when grown in between rows of *capsularis* and *olitorius* jute tended to grow somewhat better than others.	To be discontinued and replaced.
4. Study of the comparative efficacy of green manures alone or in conjunction with fertiliser on the yield of paddy.	Under local conditions, fertiliser mixture added to paddy as top-dressing gave better result.	To be continued.
5. Study of the optimum date of sowing and age of green manuring crops for incorporation when sown alone or intercropped with jute in relation to yield of paddy.	The previous year's green manuring crops, *Vigna catjang* and *Sesbania aculeata* were replaced by *Crotalaria juncea* and *Phaseolus mungo*. Green manuring alone or in conjunction with fertilisers gave equally good results so far yield of paddy was concerned.	To be continued.
6. Study of the above in relation to the yield of wheat	Of the green manuring crops sown in between jute lines, *Phaseolus* showed better performance than *Crotalaria* so far as growth	To be continued.

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	was concerned. *Phaseolus* inter-cropped with jute gave equally good yield of wheat as compared to *Phaseolus* or *Crotalaria* alone.	
7. Study on the effect of green manures, manures and fertilisers on the yield of paddy.	Highest yield of 32.09 mds. per acre was obtained from paddy when compost was added to paddy as a basal dose and paddy transplanted at optimum transplanting date.	To be continued.
VII. Soil, biochemical and microbiological studies		
1. Soil Exhaustion studies.		
A. Soil exhaustion studies in double cropping plots.	Yield of wheat was not affected when jute was grown as a preceding crop provided date of sowing were the same and recommended practices were followed.	To be continued.
B. Soil exhaustion by different varieties of jute.	A new experiment has been started. Data under study.	To be continued.

C. Changes in nutrient status of soils.		
(a) In heavily fertilized land.	A new experiment has been started with different doses and combination of inorganic fertilizer and organic manures, as also with or without phosphates and lime.	To be continued.
(b) Soil nitrogen.		
(i) Chemical.	No work could be done.	To be continued.
(ii) Microbiological.	Two strains of Azotobacter have been isolated and their effect on jute is under study.	To be continued.
(c) Soil Phosphorus.	Last year's experiment continued and a new experiment with different phosphates as a source of phosphate has been started. Some responses of the basic slag have been observed.	To be continued.
D. Withdrawal of nutrients by the jute plant.		
(a) Accumulation of inorganic nutrient ions in the tip leaves (shoot apex.).	Inorganic ions in the shoot apex estimated. Similar results as previous year were obtained.	To be continued.
(b) Uptake of nitrogen and other plant nutrients by the plant.	No work could be done.	To be continued.

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2. Development of methods for determination of soil nutrient for advisory work in connection with manuring etc.	No work could be done.	To be continued.
3. Analysis of soils and manures for their chemical and mechanical constituents.		
(a) Routine analysis.	No work could be done except pH and such measurements as could be done without gas & running water.	To be continued.
(b) Soil Survey.	pH and available nutrients in some cases could only be done.	To be continued.
4. Role of soil condition regarding susceptibility of diseases.	The influence of trace elements Bo, Zn, Cu, Mn, Co, Mo, Va, Mg at different doses applied for studying their effects on plant diseases. It has been observed that Mo and Cu show some beneficial effects.	To be continued.
5. Attempts to find out maximum production of jute under the influence of nitrogen.	Responses are not obtained from doses above 60 to 100 lbs. of nitrogen as ammonium sulphate depending on soil condition but higher doses can be used with phosphates or compost.	To be continued.

6. The influence of soil conditioners on soil textures.	Like Nilganj soil (Sandy loam), in heavy clay soils of Chinsurah Krilium and Tamarind Seed Powder improve the water-holding capacity.	To be continued.
7. Quality of fibre.	The role of pH in determining the colour of fibre along with iron and tannic acid were further investigated. It was seen that at the pH range of 6.4 to neutral the colouration is less. 'Shamla' colour could be removed by tamarind extract without hampering the quality to jute. Green tamarind extract lowers the quality to some extent. Removal of 'Shamla' colour of dry fibre by tamarind extract takes longer time and the residual effect is much less. Soil rich in phosphates have been found to give better quality of fibre, whilst nitrogen gives inferior quality of fibre.	To be continued.
8. Retting of jute.		
A. Action of different activators on retting of jute.	Dhaincha and sunnhemp stems when put in bundles in jute stems reduce retting period under semi-pilot condition, sunnhemp giving better results. Of the different compounds containing trace element and complex salts, potassium	To be continued.

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	persulphate at 1 p.p.m. has given the best result.	
B. Survey of retting water.	32 samples were studied.	To be continued.
C. Retting without steeping.	Work was continued with different organisms. Fibre obtained was coarse, not uniform in strength and were either rooty and/or barky.	To be continued.
D. Biochemical changes during retting.	Last year's result i.e. there were two distinct pH ranges—one acidic (3-4) and the other neutral, where the retting period was the shortest was further corroborated. The temperature 34-35°C was found optimum.	To be continued.
E. Isolation of specific microorganisms responsible for retting.	Five strains of bacteria and 11 strains of fungi have been found to possess the retting properties. It has also been found that many cultures lost their capability to ret when subcultured several times in nutrient media.	To be continued.

VIII. Diseases

1. Study of the mode of infection including stomatal behaviour of different *capsularis* strains.	No significant relationship was found between germ tube and stomatal opening. The fungus could penetrate through extra stomatal region.	Discontinued. Study of the microflora of jute fields.
2. Study of the stem-rot fungus.		
(i) Pathogenecity of B46, B43 and B45 singly and in combination with the *Pseudomonas* and *Fusarium* isolated from potato fields.	The three strains of *Rhizoctonia* alone have poor pathogenic property in early stages. B43 and B46 in combination with *Pseudomonas* sp. and also *Fusarium* sp. proved virulent.	Pathogenecity of different strains of *Rhizoctonia* will be studied under laboratory condition, singly as well as in combination with other organism associated with wilt of jute-potato fields.
(ii) Study of pathogenecity of 8 strains of the fungus against possible alternate hosts and jute seedlings.	Differences were observed amongst the 8 strains in their pathogenic property. Soil temperature was found to be an important determinant of pathogenecity.	
3. Study of biology of pathogens other than *Macrophomina phaseoli*.		
(i) Effect of seed treatment on the incidence of *anthracnose* in seedling stage.	Agrosan GN (ICI) proved to be better than other seed treating chemicals for the same cost.	Other commercial fungicides will be assessed.

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(ii) Comparative study of the allied forms of *Colletotrichum* sp. isolated from different hosts (jute) for specific identification.	The *Colletotrichum* isolated from jute in India closely resemble the Malayan and Japanese strain. It is still uncertain whether this is a form of *C. capsici* (Syd) Butt. & Bisby or is a new species *C. corchorum* Tanaka & Ikata.	(i) Study of the development of the disease to continue. (ii) Biology of the pahogen to be studied under laboratory conditions.
(iii) *Sclerotium rolfsii* Sacc.	The general incidence was low. Antagonistic activity between an actinomycete and the fungus was observed.	Routine observations will be continued.
(iv) *Ozonium* sp.	A species of *Ozonium* was found to be a virulent pathogen of jute causing seedling blight collar rot.	Study of the biology of the pathogen, under laboratory condition.
(v) Wilt disease in jute-potato fields.	A number of bacteria and *Fusaria* were isolated from wilted plants. Fresh decoction from wilted plants readily infected *C. olitorius* but pure cultures did not infect the plants.	Experiments will be conducted to ascertain the exact role of the bacteria (mainly a sp. of *Pseudomonas*), Fusaria and *Rhizoctonia*.
4. Chlorosis.		
Study of the technique of inoculation through smear.	Attempts to induce chlorosis by smearing failed both in D154 and JRC-321.	To be continued.

5. Investigations on the methods of control of diseases.		
(i) Selection and breeding of resistant types.	*Capsularis* and *olitorius* selections have been brought forward for further observation.	To be continued under the new system of classification of infected plants.
(ii) Breeding for resistance.	The F_1s of the cross between D154 and JRC-412 have resembled D154 in resistance ; selections have been made from F_2.	Fresh crosses and selection to be continued.
(iii) Grading different types of jute according to susceptibility.	Altogether six classes have been recognised. The different varieties and strains were classified according to their susceptibility.	To be continued.
(iv) Relative resistance of improved varieties.	No difference was observed amongst the different improved strains in varietal trial No. 1. JRC-412 however proved susceptible in different geographical units.	Routine observations to be continued.
(v) Study of the relative efficacy of different commercial fungicides.	Copper fungicides in general, particularly oxide (Perenox I.C.I.) proved better than thiocarbamates.	To be repeated.
(vi) Effect of different fertilizers on the incidence of diseases.	No difference was observed amongst plots receiving N, P and K, singly and in combination, under Nilgunj condition.	To be continued.
(vii) Study of effect of rotations on the incidence of wilt.	Jute-'kalai' (*Phaseolus mungo*) rotation proved helpful in reducing incidence of root-	To be continued.

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	rot. Potato cultivation has an important bearing on the incidence of wilt in jute.	
IX. Pests		
1. *Nupserha bicolor* ssp. *postbrunnea*.		
(i) Elimination of larval diapause.	Various measures were tried for elimination of larval diapause. It has been found that exposure to high humidity (above 85%) per cent during summer month is necessary for the elimination of the stage. In lower humidity mortality increases.	To be continued.
(ii) Epidemeology of the pest.	Simultaneous with the studies on the elimination of larval diapause, records were maintained for the last few years of soil temperature, rainfall and emergence of the pest under field condition. It is now found that sufficient rainfall during the early crop season would indicate early emergence of the pest and consequent damage. Similarly late rains will be associated with late incidence.	To be continued.

(iii) Extent of mortality of dormant larvae during the first off jute season.	It has been estimated that about 5 to 6 per cent of the dormant larvae die during the first off jute season under field conditions.	
(iv) Effect of raising *capsularis* jute along with *olitorius* on incidence.	Resistant *capsularis* (D154) and susceptible *olitorius* (C.G.) were raised in different proportions in the same layout. Seeds of the two jute species were mixed before sowing by actual counting. Result showed that the *capsularis* jute though resistant has no influence in preventing *Nupserha* damage on *olitorius*, it thus cannot act as a barrier crop as the pest can pick-up the type even from treatments with 98% *capsularis* and 2% *olitorius*.	To be continued.
(v) Habit of the pest during winter.	Last year's observation that the pest passes the winter in diapause stage in small pieces of stem, in the field is confirmed.	To be continued.
(vi) Effect of different levels of manures on incidence.	Observations on the incidence upto the second month stage could be continued from the NPK *olitorius* trial conducted by the Agronomy Section. Further observations could not be continued because of some agronomical practices.	To be continued.
(vii) Loss of fibre yield due to ranging proportions of damage at two stages of growth.	Damages were done artificially to crop of 150 cm. and 175 cm. in height, in different proportions. It is found that even a low per-	To be continued.

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	centage of damage decreases the yield considerably. About 8% damage done to crop of 150 cm. in height caused a decrease of 4 mds. approx. per acre while about 7% damage to crop of 175 cm. height depressed yield to about 2 mds. per acre. Soil heterogeneity has, however, tended to vitiate the result.	
(viii) Parasites.	*Neocatolaccus* sp. has been found as in previous years to be the most important parasite. Attempts to find out alternative host has not met with success.	To be continued.
2. *Pseudococcus filamentosus* var. *corymbatus*.		
(i) Phase responsible for damage.	Further tests were carried out to determine the phase responsible for damage. Previous years' observation that the first nymphal instar is responsible for damage is confirmed. Early second instar nymphs also in certain cases induce development of damage symptoms.	Investigations on control.

(ii) Effect of damage on tissue.	Further examinations of tissues from normal and affected portion showed that there is almost one and half times increase in the number of cell layers and almost two times increase in width in cortical, xylem and pith tissues of the affected portions over the normal.	
3. Selection for *Apion* resistance.	Of the 26 selections including polyploids and X-irradiated materials in the *capsularis* trial, some showed promise in comparison with the control D154. Some fresh selections have been made in both *capsularis* and *olitorius* strains and others have been brought forward.	To be continued.
4. *Anomis sabulifera.*		
(i) Time/dosage/instar/mortality relation.	0.35%, 0.5% and 0.75% D.D.T. (W.P.) (active ingredient) were used against the 1st and the 4th instar caterpillar and the rate of mortality with reference to time was recorded. Lower concentration like 0.25% and 0.5% can bring 100% mortality of 1st instars within two hours, 0.75% can do so within an hour but five hours are necessary when fourth instar caterpillar is used provided they are continually repeated within the treated field.	

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(ii) Time of exposure in DDT treated field and mortality.	In the experiment, time of exposure of the fourth instar caterpillars in 0.75% D.D.T. treated field was varied from half-an-hour to five hours with 30 minutes interval. With an exposure of half-an-hour, no mortality was recorded within the actual period under exposure. 80% mortality was recorded after removal from the treated field. Similarly, with other different times of exposure, low survival rate was observed after removal from the treated area.	
(iii) Comparative efficacy of some insecticides.	Folidol, Endrin, D.D.T., Dieldrin and Aldrin were tested against the third and fourth instar caterpillars. Various concentrations of each of these insecticides were used. Folidol at a dosage level of 0.005% (active ingredient) and Endrin at 0.03% (act. ingr.) have been found to be quite effective and superior to D.D.T. while Dieldrin and Aldrin are inferior to it.	Further investigation with Folidol.
5. *Hemitarsonemus latus.*		
Effect of Chlorobenzilate.	Different concentrations of chlorobenzilate were tested against *H. latus* keeping lime-	Investigation with other acaricides.

	sulphur (3 : 1) dust as standard. The new acaricide was not found to be of much value against this mite.	
6. *Termite.*		
Effect of Aldrin.	Various concentrations of Aldrin were tested against termite infesting roots of jute crop. It is found that 0.45% Aldrin (W.P.) when applied at a depth of 6″ below the soil reduces termite population by more than 90 per cent.	
7. Effect of DDT in soil on plant growth and fibre yield.	D.D.T. was applied in various levels as pre-sowing operation. The *capsularis* trial had to be rejected because of heterogenous crop growth. In the *olitorius* trial D.D.T. treated plots did not show retarded growth. On the contrary some of the treatments showed greater plant height and base diameter during different stages of growth and gave higher yield in comparison to control.	To be continued.
8. *Heterodera marioni.*		
Varietal difference.	Seventeen *capsularis* varieties and five *olitorius* varieties were tested. All these varieties have been found susceptible.	Investigation to find out fibre plants resistant to nematode.

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Substitute Fibres.		
1. Breeding & genetics of *Hibiscus* fibres.		
(i) Collection of types.	140 fresh samples of seeds mainly of *Hibiscus cannabinus* and *Hibiscus sabdariffa* were collected.	To be continued.
(ii) Progeny row tests.	4 progeny row trials of *cannabinus* and 3 of *sabdariffa*, were conducted. One of the *sabdariffa* trial had to be rejected due to heavy incidence of disease. Records on vigour, maturity and other characters were taken. A total of 2400 secondary selections, 624 in *cannabinus* and 1776 in *sabdariffa* were made. 6 cultures in *H. cannabinus* were superior to control but they did not produce sufficient seeds. In *H. sabdariffa* 6 cultures from first year trial No. 2 have been carried forward.	To be continued
(iii) Small scale yield trial with *Hibiscus cannabinus*.	The analysis of fibre yield in this trial was insignificant.	To be continued

(iv) Varietal trial of *H. sabdariffa*.	The trial is highly significant. R.T. 2 has given the maximum fibre yield but it is at par with R.T. 26.	To be continued.
(v) Interspecific hybridization.	68 fresh crosses of the previous years between different species of *Hibiscus* were grown. Germination and seed setting of F_1s in general were poor. 41 F_1 selections of the cross between *radiatus* × *cannabinus* were carried forward for further study. 21 F_2 families and 29 backcrosses progenies of *H. radiatus* × *H. cannabinus* were grown and studied during the year. Out of a total population of 357 F_3 plants only 1 plant ultimately survived at harvest. 200 fresh interspecific crosses between *H. radiatus* × *H. cannabinus* and also reciprocal crosses were attempted and only 96 successful crosses were obtained.	To be continued.
(vi) *Inheritance of Character.*		
(a) Inheritance of anthocyanin pigmentation.	53 F_2 families consisting of 6 different combinations of pigmentation on plant parts and 42 backcross families in *H. sabdariffa* were studied and classified during the year. 85 crosses of previous year between different pigmented grades in *H. sabdariffa* were grown and the F_1 characters were recorded. 34 fresh crosses and 169 backcrosses were obtained in	To be continued.

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	H. sabdariffa between different pigmented grades. 5 crosses of last year between flowers having white stigma and red stigma in *H. cannabinus* were grown and F_1 characters were recorded. 10 fresh crosses between white petal and yellow petal ; and 5 crosses between white petal, red stigma × yellow petal, white stigma were obtained during the year.	
(b) Inheritance of earliness in *H. cannabinus*.	3 fresh crosses between early and late strains of *H. cannabinus* were obtained during the year.	To be continued.
(c) Inheritance of leaf shape character in *H. cannabinus*.	Germination and leaf-shape character in all the F_1 families of crosses between palmately-lobed leaf and partially-lobed leaf were recorded. 22 successful back-crosses were obtained.	To be continued.
II. *Agronomy*.		
(i) Date of sowing experiment.	This experiment was continued with *H. cannabinus* and *H. sabdariffa*. Due to heavy attack of stem-rot, *H. cannabinus*	To be continued.

	was harvested at bud stage. Both in *H. cannabinus* and *H. sabdariffa* the trial was highly significant. Maximum fibre yields were obtained in *sabdariffa* in the sowing of middle of April and in *cannabinus* in the last week of April.	
(ii) Seed rate experiment with *H. cannabinus.*	The test is highly significant. Maximum fibre yield was obtained in the seed-rate of 10 lb. per acre.	To be continued.
(iii) Seed rate experiment with *H. sabdariffa.*	The trial is insignificant. Crop growth was affected due to soil heterogeneity.	To be continued.
(iv) Spacing trial with *H. sabdariffa* var. *altissima.*	The test proved insignificant.	To be continued.
(v) Manurial trial with *H. sabdariffa* var. *altissima* and *H. cannabinus.*	The treatment, nitrogen at the rate of 80 lb. per acre has given the highest yield of fibre in *H. sabdariffa.* In *H. cannabinus* the highest fibre yield has been obtained with the treatment of 60 lb. N per acre.	To be continued in randomised blocks lay-out.
(vi) Combined yield trials of different fibre crops.	The test was significant at 1% level of probability. *Sabdariffa* R.T. 2 has given the highest yield of fibre.	To be continued.
(vii) Preliminary trial of *cannabinus* and *sabdariffa* in Andhra state.	In *H. cannabinus* the yield performance of all the types are, in general, not satisfactory.	To be continued.

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	The J.A.R.I. type has, however, given higher yield of fibre than the local. In *H. Sabdariffa* R.T. 1 has given the highest fibre yield although there is not much difference with the rest of the types including the local.	
(viii) Varietal trial of *H. sabdariffa* in Orissa.	In the trial at Sambalpur, the J.A.R.I. strain R.T. 1 has given the highest yield of fibre being 18.4% over the local. The growth of the crop was not satisfactory due to late sowing and water-logged conditions of the land. The trial at Bolangir had to be rejected due to defective layout of the experiment.	To be continued.
Other Fibres		
(i) Sunnhemp.	Morphological characters of different collections of sunnhemp and other species of *Crotalaria* were recorded. Out of the three trials conducted in U.P. only one at Mangari came out successful and the rest two had to be abandoned due to heavy floods. The J.A.R.I.	To be continued.

	strain S.T. 42 and the standard strain K-12 have given higher fibre yield in the trial at Mangari.	
(ii) Linseed.	Different dual purpose linseed strains were grown for observation in small plots and different morphological characters were recorded. The yield trial with 17 strains of linseed was repeated this year. The analysis of straw and seed yield data not yet completed.	To be continued.
(iii) Ramie.	Fresh planting of ramie raised from seeds and slips were done. A small scale spacing-cum-manurial trial is in progress.	To be continued.
(iv) *Agave* and *Furcraea.*	Fresh suckers of *A. wightii*, *A. sisalana* were received and grown in nursery plots.	To be continued.
D. *Seed Multiplication.*	Seeds of different fibre crops were multiplied on a small scale and some quantity was released for sale.	To be continued.
III. *Anatomy* and *Cytogenetics.*		
1. Study of distinguishing features of fibre bundles in substitutes and characteristics of ultimate fibre cells.	Length and breadth of ultimate fibres of standard samples of *Agave sisalana* were studied. Study showed that *A. cantala* fibres are longer and narrower than *A. sisalana.*	To be continued.

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2. Leaf and fibre development in *Agave* spp.	The development of the leaf is initiated near the apical region. The growth of the leaf is maintained by a meristematic region at the base of the leaf. The ultimate fibres develop from the parenchyma cells in the vicinity of the vascular bundles and the repeated divisions of those cells a kidney shaped bundle of fibre if formed covering the vascular bundle. In case of bigger bundles, two arcs are formed almost encircling the vascular bundle.	Completed.
Cytological Studies.	The pairing relationship of the F_1 hybrids (*H. cannabinus* × *H. radiatus*) clearly points out that some fundamental differences exist between the chromosome complexes of both the parental species.	Effect of date of sowing on the fibre content of *altissima*. To be continued.
Diseases of the *cannabinus*.	Studies on Brown-rot due to the attack of *Volutella* sp. leaf infection due to *Phoma sabdariffa* and root-rot due to *Macrophomina* and *Fusarium* were continued.	To be continued.

Disease of *H sabdariffa.*	Studies on root-rot caused by *Macrophomina* and *Fusarium* was continued.	To be continued.
Disease of *C. juncea.*	Sunnhemp was found to be highly susceptible to root-rot due to *Fusarium vasinfection.* Selections proved equally susceptible.	To be continued.
Pests.		
1. *Agrilus acutus.*		
(a) Biology of the pest.	Incidence of the pest is on gradual increase. Investigation as to how the development of gall is induced and the stage of larva responsible has not yet met with success.	To be continued.
(b) Effect of different dates of sowing on incidence.	*H. cannabinus* sown during the middle of April showed higher incidence than others. Late sown crop showed negligible incidence.	To be continued.
(c) Varietal difference.	Amongst the varieties under *H. cannabinus* the J.A.R.I. strain M.T. No. 15 showed comparatively less incidence. No difference on incidence was observed amongst the varieties under *H. sabdariffa.*	To be continued.
2. Transmission of mesta virus.		
(i) Seed transmission.	Virus is not seed transmitted. Progenies of the virus affected plants did not show up any symptoms in their second generation in succession.	To be continued.

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(ii) Insect transmission.	Studies on the determination of vector species suffered as sufficient virus affected plants were not available.	To be continued.
Extension		
1. Demonstration of jute cultivation in cultivators plot.	Improved techniques were demonstrated in 153 plots selected in cultivators' area in 7 extension centres.	To be continued.
2. Collection of data regarding enquiry into Agro-economics of the jute cultivation of the 7 extension centres.	Necessary data collected.	To be continued.
4. Teaching and educating the rural people regarding the improved methods of jute cultivation and allied crops.	1. Agricultural show was held at J.A.R.I. during the Farmers Week. 2. Farmers Forum was arranged to enable farmers to ventilate their views and present their problems and needs. 3. Individual contacts and group meetings were organised in 52 villages in 7 extension centres.	To be continued.
		Opening of four jute developmet blocks in Assam, Orissa, Bihar and U.P. provided substations are opened there.

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